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Industry Power

A Putman Publication / Executive Magazines for Industry

SEPTEMBER 1957

For the Power Services

Management Team

UNIONS FOR ENGINEERS?

HARRY H. RAINS, ATTORNEY
INDUSTRIAL RELATIONS COUNSELLOR

"True attainment of professional status will still lie on the shoulders of the individual engineer . . . "

JOSEPH AMANN, PRESIDENT
ENGINEERS AND SCIENTISTS OF AMERICA

"Whether they be the small Spanish variety or the large jumbo variety, the fact remains that engineers are still being paid peanuts."

One of a series.

Some Things to Think About Steam Traps

. . . in order to get high operating efficiency and a minimum of maintenance

The gentleman who invented the wheel had a basic idea and so far no one has come up with anything better for the purpose.

If you'll pardon us for a little overemphasis on the significance of steam traps, we'd like to liken one of them to the wheel.

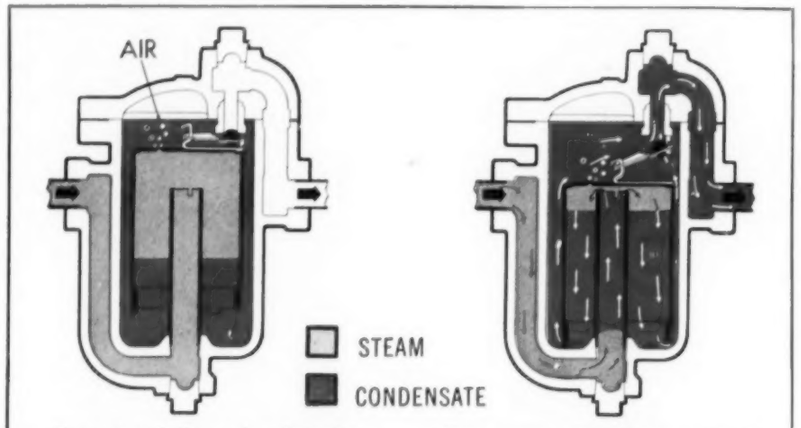
In 1911, when the first Armstrong inverted bucket steam trap model was announced to the world, or at least that part of the world that modest advertising and sales budgets would cover, it was not received with equal enthusiasm by all (especially old-style trap makers). But, like the wheel, it managed to find its way into general use. And, nothing better has ever turned up for the purpose of draining condensate. As a matter of fact, the Armstrong trap has been very widely copied. Today, there are more inverted bucket traps draining process equipment than any other kind. Of these, there are more Armstrongs.

If this sounds like the boasting of a proud parent, give consideration to some fundamental requirements not met by all traps:

1. ***A steam trap should not leak steam.*** Some traps do, you know, because of the nature of their operating principle. No steam ever gets to the Armstrong trap orifice. The valve is always water sealed.

2. ***A steam trap should vent "air" as fast as it accumulates***—otherwise temperatures are reduced and corrosion is a problem. The Armstrong trap handles air very nicely. The vent in the bucket permits air to accumulate in the top of the trap, from where it is discharged when the trap opens. For extreme conditions like draining paper machine dryers, some jacketed kettles and certain other units, the vent is sized larger for the job. And, for handling big volumes of air during warm-up, a bucket with an auxiliary thermic vent really speeds up heating.

3. ***A steam trap should discharge condensate at steam temperature*** if you want to get maximum efficiency from the unit drained. And most people certainly do. If you have to wait for the condensate to cool, it's almost impossible to maintain maximum temperatures and prevent air build-up. You guessed it—the Armstrong trap opens for water, without dependence on temperature.



Trap closed. Steam has floated inverted bucket; valve is held tightly closed by system pressure. Air entering trap passes through bucket vent and accumulates at top of trap.

Trap open. Condensate entering trap has caused bucket to lose buoyancy. Weight of bucket times leverage pulls valve open. Air is discharged along with condensate.

4. ***A steam trap should be suitable for any return system.*** The Armstrong trap works just the same whether discharging to atmosphere, back pressure or vacuum. It has been conclusively proved that flash steam resulting from use of a bucket trap does not cause a problem in vacuum return systems. The flash condenses rapidly. It's the leaky traps that cause the headaches.

5. ***A steam trap should not be a "prima donna".*** Some kinds of traps take an awful lot of care and coddling. The Armstrong trap is a rough and ready type with a hardened chrome steel constitution (valve and seat, to be exact). It cleans itself of ordinary dirt and scale without choking up. Its 18-8 stainless parts stave off rust and corrosion. It resists wire-drawing and wear remarkably well. In fact, it stays on the job longer with less attention than any trap ever produced. Unless you live in Siberia, you can probably find a user around the corner who will tell you so from experience.

6. ***A trap should not be an "orphan".*** With Armstrong traps you can *always* get prompt service and parts from nearby Factory Representatives and stocking distributors as well as from the factory.

7. ***A trap should have a guarantee.*** The Armstrong trap is unconditionally guaranteed to give you *complete satisfaction* (as to doing its job, that is). If it doesn't, you can get your money back.

If you'd like to buy some of these excellent steam traps, call your local Armstrong Representative or write **Armstrong Machine Works, 8204 Maple St., Three Rivers, Michigan.**

ASK FOR the 44-page Steam Trap Book, free on request without obligation.

ARMSTRONG STEAM TRAPS

Circle 120 on READ-N-CIRCLE card for more data

Industry Power

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A PUTMAN PUBLICATION

Industry Power

FOR THE POWER SERVICES MANAGEMENT TEAM

VOLUME 73 NO. 4 SEPTEMBER 1957

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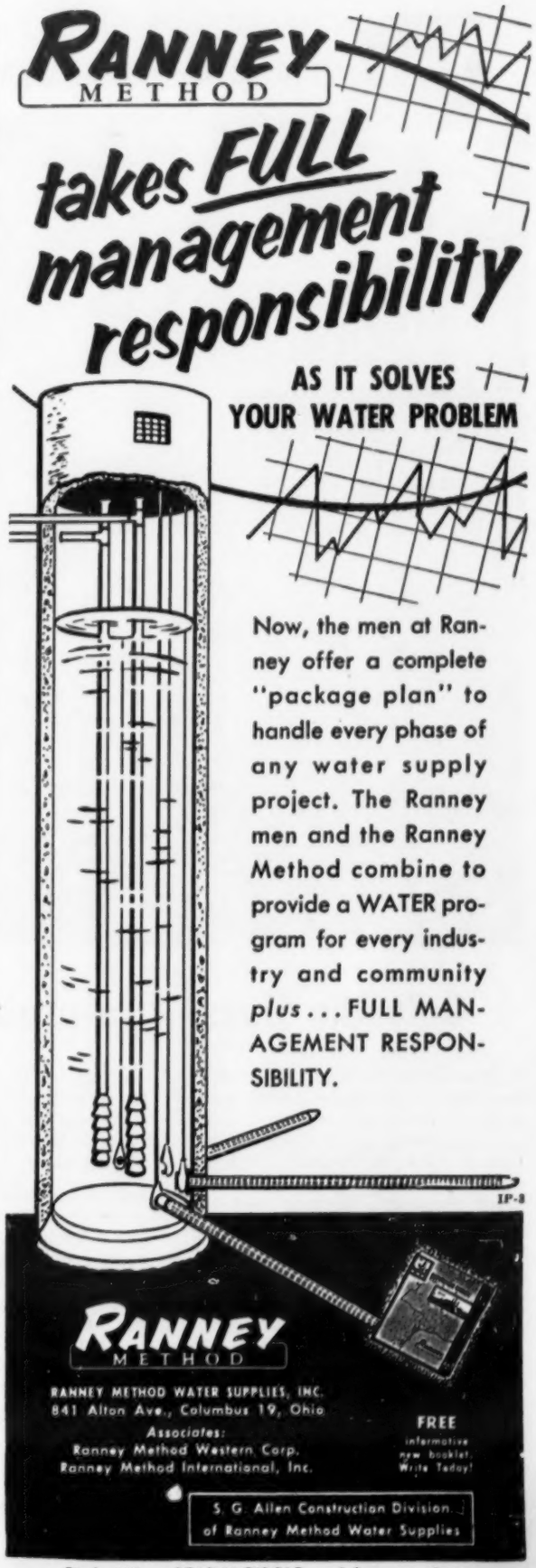
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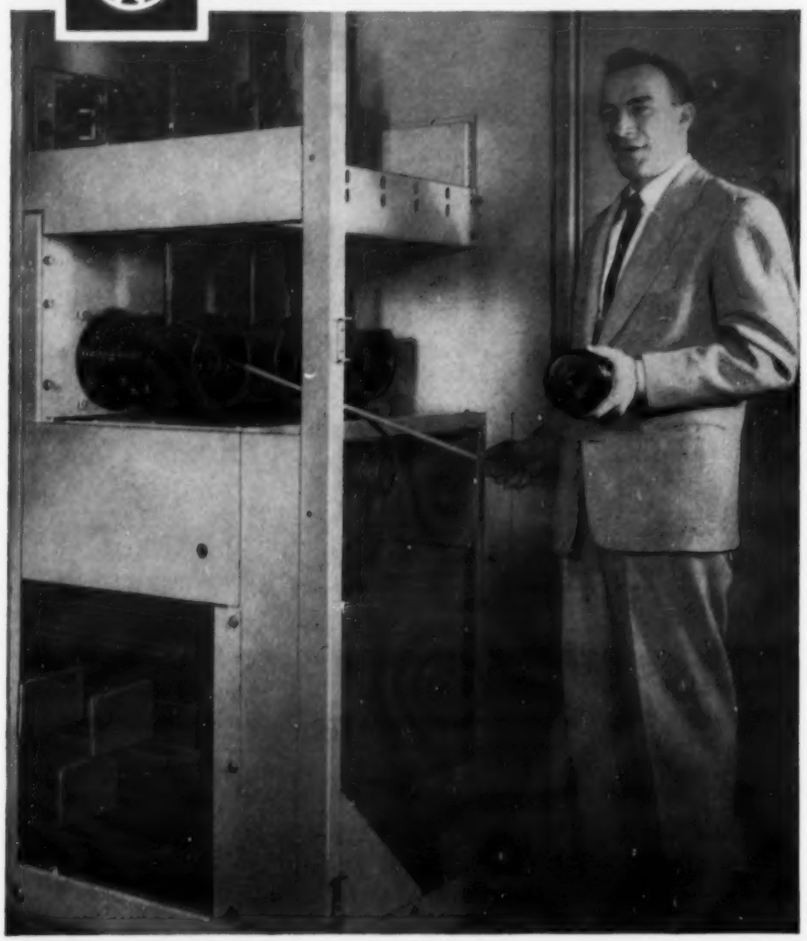
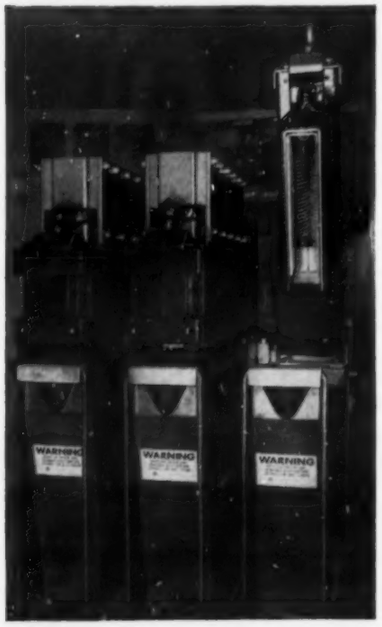
METAL-CLAD SWITCHGEAR



PURIFIED PORCELAIN in horizontal and vertical bus supports, primary disconnect bushings and caps and epoxy in bus joint covers provide excellent insulation, prevent fires in 15 kv I-T-E metal-clad switchgear.



EPOXY AND SPECIAL CERAMICS protect personnel and equipment by preventing fires in the circuit breaker section. Arc chute rear supports and blowout coils are epoxy. Jump gap cooling plates, arc chute liner plates, arc plates and spacers are special ceramics.

Only the finest fire-protective insulating materials

Nonflammable porcelain and ceramics, flame-resistant epoxy, and other flame-retardant insulating materials throughout, are among the extra values you find in I-T-E Metal-Clad Switchgear. Purified porcelain, of which the primary disconnect bushings and caps are made, also supports both vertical and horizontal bus. It is nonflammable, has high dielectric strength, won't track or deteriorate, is inherently contamination free.

Epoxy, which can be molded into complicated shapes, forms arc chute rear supports, blowout coils, bus joint covers, potential and current transformers. It has high mechanical and dielectric strength, is nontracking and extremely flame resistant.

Special ceramics, highly resistant to direct arc exposure, are used in jump gap cooling plates, arc chute liner plates, arc plates and spacers. These have high dielectric strength, low moisture absorption, won't track, are excellent interrupting materials. They do not deteriorate when subjected to direct arc exposure. They absorb thermal shock and deionize gases without excessive heating.

Phenolic and polyester insulating sheets and moldings, specially treated to provide the highest possible degree of flame-retardant characteristics, are also used.

If you are planning new construction or modernization requiring electric power, consider the advantages of I-T-E equipment. Consult your local I-T-E sales office or write I-T-E Circuit Breaker Company, 19th & Hamilton Sts., Philadelphia 30, Pa.

I-T-E CIRCUIT BREAKER COMPANY • Switchgear Division

IN CANADA: EASTERN POWER DEVICES, LTD.

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IP news

Increase in leisure time leads to "moonlighting"

Moonlighting . . . the increasing practice of holding down two jobs at the same time . . . is on the rise, says National Industrial Conference Board. Motivation stems from increased leisure afforded by 35- to 40-hour week, plus actual need arising from continuing increases in living costs. Conference Board estimates there are "several million" moonlighters now drawing two paychecks from different employers.

Sign contracts for $25 million in new boilers

Four utility companies will pay Combustion Engineering, Inc., more than $25 million for new boilers that will supply 1,270,000 kw electric power. Units and uses are: 340,000-kw unit for Consolidated Edison Co.'s Astoria Station; two 240,000-kw units for the Port Everglades Power Station of the Florida Power and Light Co.; 330,000-kw unit for a new Harrisburg, Pa., station being built by Pennsylvania Power & Light Co.; and a 120,000-kw unit for the P. L. Bartow Station, Florida Power Corp. Larger units will be controlled circulation boilers specially designed for high-pressure, high-capacity installations.

$2 million order for gas turbines placed

Three gas turbines, costing over $2 million, are ordered for new Lake Charles, La., plant of Petroleum Chemicals, Inc. Order, placed by The Lummus Co. with General Electric Co., calls for two units rated 13,000 hp. Turbines will drive eight compressors for PCI's ethylene production plant. Turbine exhaust will pass through heat recovery boilers to produce process steam for plant use.

First ISA Fellowship goes to Case Institute

With a graduate program in instrumentation and control engineering said to be "second to

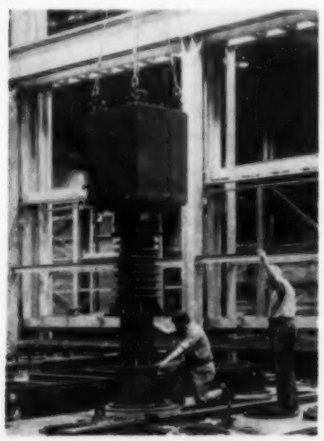
none," Case Institute of Technology, Cleveland, Ohio, is awarded first $4000 Instrument Society of America Fellowship. Formal award of the Fellowship to Case will be made as part of the ISA Instrument-Automation Conference and Exhibit September 9-13 at Cleveland.

More nuclear technology fellowships offered by AEC

Applications are again being accepted for AEC's special fellowships in nuclear technology. Fellowships are a part of general program of assistance to alleviate shortages of trained nuclear scientists and engineers. Applications must be submitted to Oak Ridge, Tenn. office of AEC no later than October 15.

New autotransformers have LTC mechanism on bushings

Built to facilitate high-voltage system interconnection, the largest bushing-mounted load-tap-changing mechanism ever built



is readied for use. General Electric Co. workmen are installing 120-kv bushing with load-tap-changing contactor. Tap selector is in tank next to high-voltage winding of this 125,000-kva autotransformer, one of two being installed at Niagara Mohawk Corp.'s Gardenville station.

Freezing air will heat new Sylvania research center

Below-freezing winter air will supply heat for new research and development center Sylvania Electric Co. is building at Amherst, N. Y. York Corp. will use compound compression air source heat pump system for the center, employing same equipment to cool the 90,000

"they're easy and simple to take care of"

"Spare parts for a whole plantful take only a corner of a cabinet."

Q. Mr. Baker*, as Superintendent of Plant and Structures of the Newark Beth Israel Hospital, you've used a good many Yarway Impulse Steam Traps in the last 20 years. What, in your opinion, are their main advantages?

A. The big thing is that they're easy and simple to take care of. In many cases, they can replace traps much bigger and heavier. Then, too, they seldom give us any trouble. Usually we install 'em and forget 'em. When they do need service, replacement of the little valve is the worst that can happen, and that only takes a couple of minutes.

Q. What do your operating men think of Yarway traps?

A. Twenty years ago, when the Yarway Impulse Trap was introduced as a new idea in steam traps, it made sense to me and I ordered some. My men, however, insisted they wouldn't work. I finally put on a demonstration on a steam leg down in the boiler room, and they were convinced. Now they are as enthusiastic as I am.

Q. How many Yarway Impulse Traps are installed around the plant?

A. I don't know exactly. They're all over the place. Certainly over 100. We have them throughout the laundry and kitchen, on all the steam tables and coffee urns in the cafeterias, in the operating rooms and Central Supply on sterilizers, autoclaves and stills, in the boiler room on fuel oil heaters, high and low pressure lines, and on steam line drips everywhere in the plant. To service all these, our inventory of spares and repair parts takes, as you can see, only a little corner in a filing cabinet.

Q. We notice a few traps of other makes around. How do you explain that?

A. Well, some equipment gets installed with other traps on it—but first excuse we get, we replace 'em with Yarways!

"This Yarway Impulse Trap on drip line replaced a conventional trap that needed a platform to support it."

If you would like a copy of a new, helpful booklet, "The Why and How of Steam Trapping" drop a card to

YARNALL-WARING COMPANY
100 Mermaid Ave.,
Philadelphia 18, Pa.

**GEORGE E. BAKER, Supt. Plant and Structures, Newark Beth Israel Hospital, Newark, N. J.*

YARWAY impulse ...a good way to specify steam traps

OVER 1,200,000 YARWAY IMPULSE STEAM TRAPS ALREADY USED • STOCKED AND SOLD BY 275 CONVENIENT LOCAL INDUSTRIAL DISTRIBUTORS • NATION-WIDE YARWAY ENGINEERING STAFF AVAILABLE FOR SERVICE.

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sq ft building. No fossil fuels or supplementary heaters will be necessary. System has 250-ton cooling capacity, can provide 2,400,000 Btu for heating.

There's still an engineer shortage, says educator

"Do not believe reports there is no longer a shortage of engineers and scientists," Dr. John R. Mayor, director of education for the American Association for the Advancement of Science, tells high school teachers. Speaking at Michigan State University's Science Institute, Dr. Mayor says a recent survey shows that in Southern California alone there are 30,000 engineers employed, with area industries indicating they would hire 60,000 more if available.

AEC releases 44 patents for industrial use

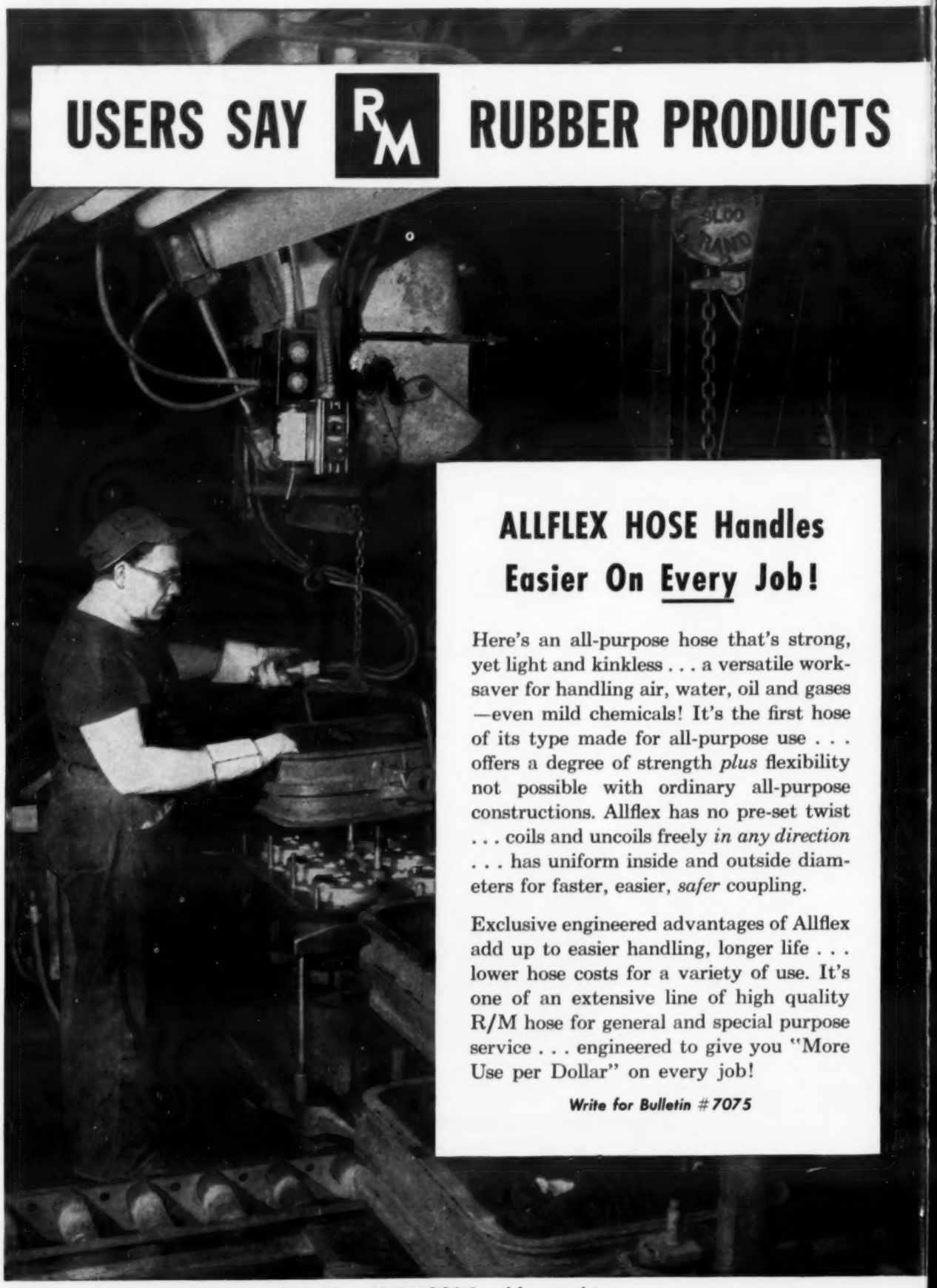
Stepping up its program to make non-secret technological information available to industry, AEC releases description of 44 patents. Owned by U. S., patents cover a wide range of atomic "know-how," have long been on the restricted list.

Take it easy on "exotic" fuels speculation

A cautious approach by investors and speculators in the field of high energy "exotic" fuels is advised by Nuclear-Atomic Economic Survey, New York counseling firm. Survey by the firm reviews profit and loss prospects in securities representing titanium, columbium, rare earths, boron, uranium, and thorium. Counsellors warn that "exotic" may well be "quixotic" as far as investors are concerned.

Gilsonite now producing low-cost "crude" from shale

Breaking through the synthetic fuel barrier, American Gilsonite Co. is now producing crude oil from shiny black Colorado shale for "considerably less" than $1.87/bbl compared to current price of between $2.20 and $4/bbl cost of con-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ALLFLEX HOSE Handles Easier On Every Job!
Here's an all-purpose hose that's strong, yet light and kinkless . . . a versatile work-saver for handling air, water, oil and gases —even mild chemicals! It's the first hose of its type made for all-purpose use . . . offers a degree of strength *plus* flexibility not possible with ordinary all-purpose constructions. Allflex has no pre-set twist . . . coils and uncoils freely *in any direction* . . . has uniform inside and outside diameters for faster, easier, *safer* coupling.
Exclusive engineered advantages of Allflex add up to easier handling, longer life . . . lower hose costs for a variety of use. It's one of an extensive line of high quality R/M hose for general and special purpose service . . . engineered to give you "More Use per Dollar" on every job!
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R/M CONVEYOR BELTS... You Name the Service

Whatever material or products you are conveying, chances are R/M has the rubber conveyor belt engineered specifically for the job. Ray-Man Conveyor Belt, for example, is designed for heavy loading of bulk materials. Strength Members are cushioned. Double compensation relieves stress on outer plies . . . This assures extra flexibility even where relatively thick, narrow belts are used or where pulleys are small. Use of newest synthetic super-strength fibers means greater service than ever before . . . holds fasteners under the most severe conditions . . . requires no breaker ply. Like all R/M heavy duty conveyor belts, Ray-Man is moisture-resistant . . . mildew-proof . . . protected against wear, tear, cuts and abrasion with R/M's exclusive "XDC" Cover!

An R/M representative helps you select the best construction for "More Use per Dollar" on your job.

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More Power in Less Space... if it's R/M POLY-V® Drive!

This entirely new, patented, power transmission drive features a *single, endless* parallel V-ribbed belt running on sheaves specially designed to mate precisely with the belt ribs. The results? *Uniform* belt pull, *even* distribution of drive load . . . highest horsepower capacity per inch of drive width. Gives you up to 50% more power than a conventional V-belt drive of equal width . . . or the *same* power in as little as ⅔ the space!

Belt matching problems are eliminated . . . belt speed ratio and belt position remain more constant from no load to full load for smoother, cooler running, less wear. Just *two* cross sections of Poly-V* Belt meet *every* heavy duty power requirement.

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ventional crude oil. American Gilsonite's president, E. F. Goodner, says breakthrough adds equivalent of a major oil field to nation's reserves, proves that oil may now be mined as well as drilled.

Seattle hydro plant gets new runners

$400,000 rebuilding order is awarded S. Morgan Smith Co. by City of Seattle, Wash. for rebuilding city's Diablo plant on Skagit River. New 144-in. carbon steel runners are principal part of contract. Runners are designed to enable Diablo plant to develop 115,000 hp at 171.5 rpm under rated head of 318 ft.

Radioactive oil gives inside story on performance

Engine researchers can know from minute-to-minute exactly what goes on inside modern high-compression engines. New

application of radioactive materials in lube oil is providing an engine "basal metabolism" for research engineers of Cooper-Bessemer Corp. Using lube oil with radioactive materials, engineers gain information in minutes on tests that once took 100 hours' running time.

Cooperation urged between engineers, power services

Increased cooperation among consulting engineers, both in private practice and industry, and power users and electric utility representatives is urged by M. A. Bostwick, protection engineer for Portland General Electric Co. During recent west coast meeting of AIEE, Bostwick commented "Better economic solutions to power users'

news
. . . starts on page 4

problem of providing selective protection can be gained from cooperative efforts of consulting engineers, plant engineers and those of supplying utility."

APPR successfully makes 700-hour performance test

Army's new Package Power Reactor, recently installed at Ft. Belvoir, Va., successfully completes 700-hour performance test with only 8 hours' shutdown during test period. During first 600 hours, APPR generated electricity exceeding rated design, produced 1,181,000 kw during test.

New appointments, honors, promotions in power field

Paul J. Cristianson, general counsel, succeeds Henry G. Riter III as president, Thomas A. Edison Industries Div., McGraw-Edison Co. Henry G. Riter IV is named executive vice president of the Edison Industries. Riter III, will assume duties January 1, 1958, as director of corporate relations for McGraw-Edison, parent firm.

Herbert Hoover III San Jose, Calif., grandson of former President Herbert Hoover, is named junior member of Society of Petroleum Engineers.

Four outstanding engineers are elevated to rank of Fellow of ASME. Myron R. Bowerman, Director of Research for Alliance Machine Co., Alliance, Ohio; Irvin H. Fullmer, National Bureau of Standards, Washington, D. C.; Rawleigh Johnson. Ingersoll-Rand Co., Phillipsburg, Pa.; and John A. Worthington, manager, Koppers Co., Baltimore, are new Fellows.

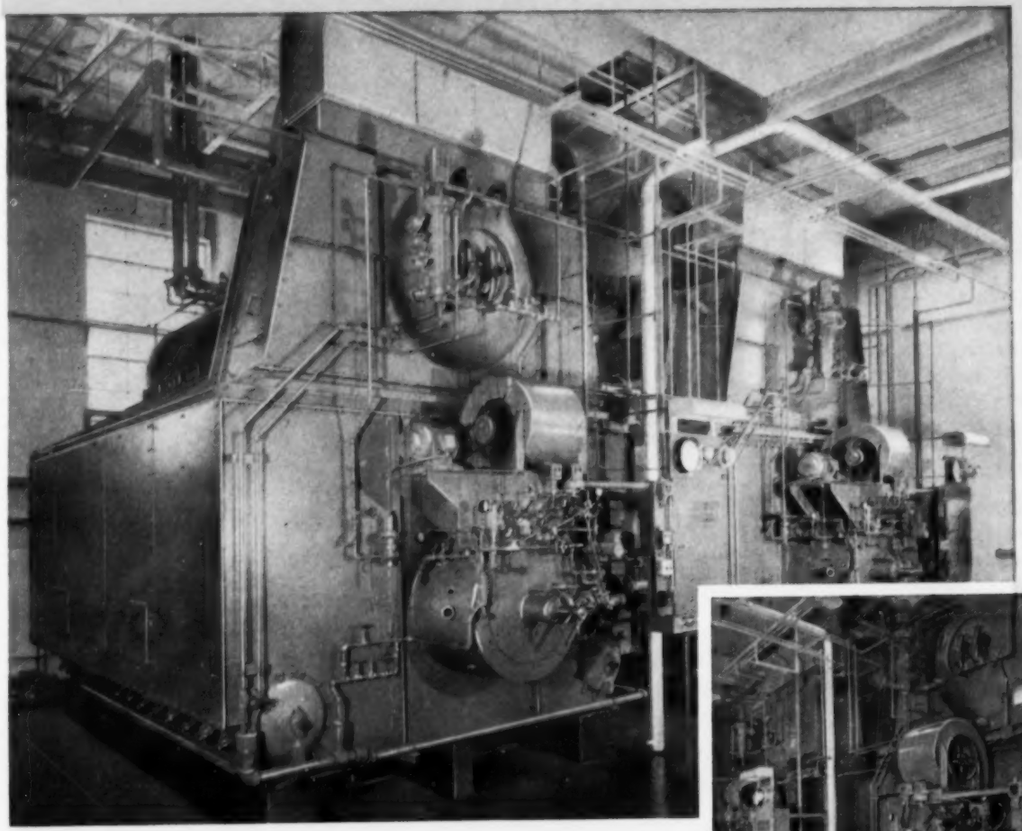
ASME also names two new assistant secretaries of the 50,000-member society. Thev are: John D. Wilding, staff member since 1954, and William E. Reaser, former professor of engineering, Princeton University.

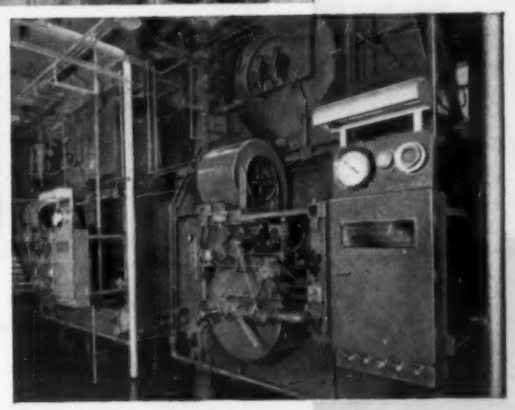
Appointment of Bartow Van Ness, Jr. to post of assistant chief electrical engineer heads recent personnel changes at Pennsylvania Power & Light Co. Other promotions include: Walter B. Morton, chief electrical

FOR UNFAILING, ECONOMICAL SERVICE,

WICKES Type A, shop-assembled

specified for the Edward W. Sparrow





Wickes Type-A Steam Generators combine custom engineering and shop-assembly to give you economical "packaged power" to exactly meet the load requirement. The entire unit is shipped complete ready to set on your foundation and installation can be made with minimum interruption of your production schedules. All necessary auxiliary equipment including trimmings, soot blowers, feed water regulators and other accessories, are shop-installed leaving field installation at a minimum. From the pressure-tight casing to the oil-gas burner, Wickes type-A water tube steam generators with capacities up to 60,000 lbs. of steam per hour are designed and engineered to be the standard of quality and performance in a variety of industries.

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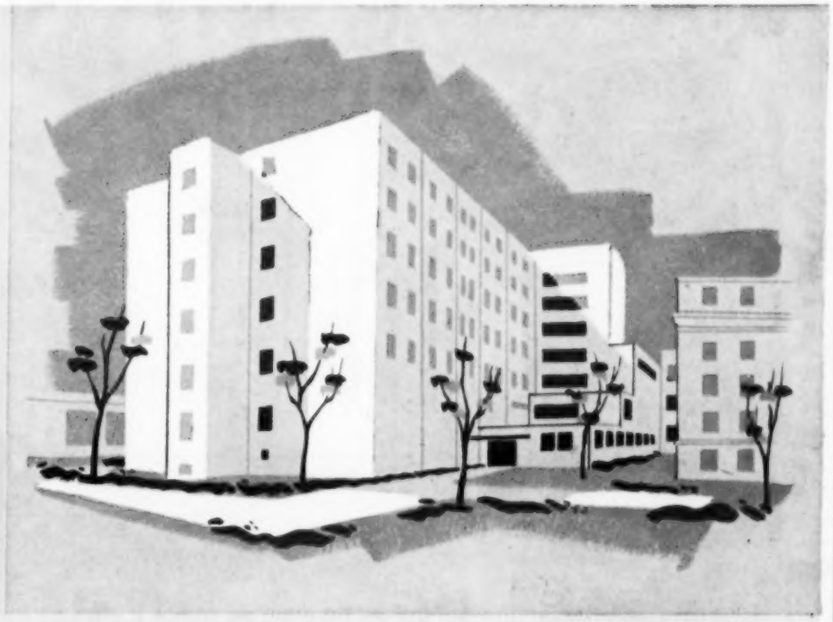
boilers are

hospital



Architects sketch of new Sparrow Hospital.
Architects: O. J. Munson Associates–Lansing, Michigan.
Professional Engineers: E. Roger Hewitt Associates, Inc.–Lansing, Michigan.

One of the most important considerations in hospital construction specifications is the steam generation system, because it must give around-the-clock reliability without failure. It is significant, then, that for the Edward W. Sparrow Hospital in Lansing, Michigan, two Wickes shop-assembled Type-A Steam Generators have been installed to provide a dependable source of heat. The new units, which are housed, in a completely new boiler house, replace the original Wickes coal fired boilers. Each of these two new boilers are capable of producing 18,500 lbs. of steam per hour at an operating pressure of 125 psi. They provide 2250 square feet of heating surface and are equipped with fully automatic Wickes combination oil and gas burners. These units have a design pressure of 160 psi.

Write for our Catalog 56-1 for detailed information on Wickes Type-A Boilers, and we will also include our Bulletin 55-1 covering the complete line of Wickes Products and Facilities.

WICKES

THE WICKES BOILER CO.

DIVISION OF THE WICKES CORPORATION, SAGINAW, MICHIGAN

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engineer; M. C. Engle, chief mechanical engineer; C. A. Carpenter, chief system planning engineer; Stanley C. Townsend, manager, atomic engineering; William H. Stand, manager, engineering services; B. C. Seitzinger, construction manager; and E. P. Welch, assistant manager, engineering services.

Demski Schmidt

Robert G. Schmidt, right, is project manager for new $4 million Lawrence, Kan., plant of Callery Chemical Co. Stanley J. Demski, left, becomes construction manager for the Lawrence plant. Plant will produce boron fuel for commercial use.

H. W. Cory is named assistant manager, control department; and W. F. Eagan, engineer-in-charge, control engineering by Allis-Chalmers Manufacturing Co. Harold G. Zambell is appointed engineer-in-charge, test and development, at A-C's Terre Haute, Ind., works.

Jordan Manor

Paul Jordan, left, plant engineer at Dodge Manufacturing Corp., Mishawaka, Ind., is new director of engineering at Indiana firm.

Paul A. Manor, right, is promoted to chief engineer, Central Valve Research and Development Dept., Rockwell Manufacturing Co.

Westinghouse starts new atomic projects

Construction of first industry-owned nuclear materials testing reactor is started by Westinghouse Electric Corp. at site near Pittsburgh, Pa. Testing reactor will operate in range of 20,000

Since 1875 Chapman Valves for the Power Industry

Cross section of special Chapman Valve of the type used on the primary coolant loop of the first atomic submarine, the Nautilus. Operates at 2000 lb. pressure at 600°F.

Since the days when a 300 pound steam valve was considered an important development, the Valve Industry has added many higher standard pressure ratings. New and special valves have also been developed and built by Chapman, including primary coolant valves for the Nautilus; Mark I and II; A1W and S5W Valves for the first large ship reactors; valves for the Dresden reactor; and many others.

Chapman Valve, since its organization in 1875, has kept in step with developments in the Power Industry; meeting promptly and efficiently the demands for valves to withstand increased pressure and temperature specifications. The Chapman line today covers a complete standard range to 2500 lb. and special designs for super-critical pressures.

Keeping pace with the Power Industry . . . keeping pace with all industries . . . has kept Chapman alive and aggressive. Every phase of manufacturing is under close supervision. Chapman foundries manufacture its casting requirements under technical supervision with results checked by a million volt x-ray machine to insure a maximum quality product. All Chapman equipment and operations are designed to meet exacting demands with valves that give top performance with the lowest maintenance cost.

The CHAPMAN Valve Manufacturing Co.

INDIAN ORCHARD, MASSACHUSETTS

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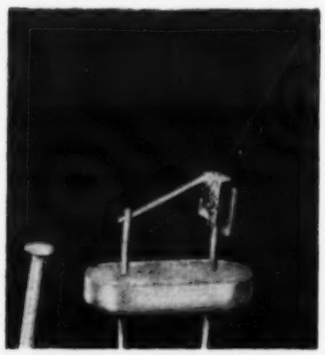
IP news

. . . starts on page 4

kw or above, will test materials under conditions similar to those of power reactor. Westinghouse is also carrying out development work for AEC's Sherwood Project, aimed at achievement of controlled thermonuclear power. Westinghouse is working on vacuum techniques for project at its research laboratories.

"Spacistor" is invention of Raytheon researchers

A major step forward in amplifying electric energy is spacistor. New semiconductor device, as tiny as a transistor, operates electrically like a vacuum tube. Raytheon research scientists pre-



dict spacistor will amplify at frequencies up to 10,000 mc – as much as 50 times higher than transistors. Because spacistors can be made from materials unsuited for transistors, Raytheon predicts they will operate at temperatures as high as 500 C, double the operating range of today's transistors.

Nuclear reactors for heat processing?

Some industries may be missing a valuable bet by overlooking possibility of using nuclear reactors for heat processing, says "Atoms for Peace." Present reactors are far better suited to produce steam and heat for some industrial uses than they are for electric power. Existing reactors produce low-temperature steam, inherently unsuited to economical electric power generation but potentially of great value to industries employing low-temperature steam, survey concludes. ♦♦

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this month's comment . . . .

. . . clearing the confusion

By now, it seems that just about everybody has entered into the "engineering shortage" act. It appears as though mentioning this subject in a speech assures the speaker of an unprecedented reception. The result of all this discussion is, as might be expected, utter and complete confusion. The employers' spokesmen insist that the shortage of engineers is so real and so acute that we are virtually in the midst of an international crisis. The employees argue forcefully that the shortage is blown up beyond all recognition, that engineering manpower is just not being utilized to best advantage. Both arguments have merit, but it is time to sort the "go-getters" from the "groaners".

This is why the editors of INDUSTRY POWER are making a survey. We want to uncover the true feelings of you, the nation's practicing engineers. You are the people most vitally affected.

Already, many of you have received a questionnaire "What's This Engineering Shortage All About?" asking for your honest opinions. When the replies are in and sorted, we will publish the results of the survey.

It is easy to blame many business problems on the grounds of the engineering shortage. But surely it is evident that our whole engineering employment policy needs a complete overhaul. The methods we used in an era when our technology advanced at a more leisurely pace, when the stakes were comparatively low, simply are not adequate for today's needs. Engineering must not be regarded as an overhead, to be pruned whenever the budget gets out of hand. Management must make an effort to get the best use from the engineering skills it already has, nurturing them to full growth. We hope the survey results will provide some specific guideposts on this question.

Donald Hartley

Managing Editor

Unions for

UNIONS FOR ENGINEERS — YES or NO? While this
certainly a question worthy of your sharpest and clearest
are presenting the PROS and CONS of this vital,
agree with Mr. Amann or with Mr. Rains? Or, do you
comments to the Editors of INDUSTRY POWER. We are

About Joseph Amann

Born in Richardton, North Dakota in 1918, Joseph Amann spent his youthful years on his father's farm near Richardton, where he developed an interest in machines and gadgets. He began his college career in aeronautical engineering, but switched to physics in his second year. He obtained a masters degree in that field.

He was employed by the Ford Motor Company in Detroit for a short time after graduation from college. In 1943, he joined the Minneapolis Honeywell Regulator Company, and in 1948, he became active in the affairs of the Federation of Honeywell Engineers – the bargaining agent for the engineers and scientists at Honeywell's Minneapolis operation. He served two terms as the Federation's president, in 1950 and '51.

In 1952, Mr. Amann was one of the leaders of the movement to establish the national engineers union which eventually became the Engineers and Scientists of America.

He served as chairman of the Constitutional Conventions at which ESA was founded. He was elected as the first president and has been re-elected annually since.

Mr. Amann is a member of the Committee on Specialized Personnel of the Office of Defense Mobilization and a member of the President's Committee for Employment of the Physically Handicapped. He is also active in the Industrial Relations Research Association and in several technical and professional societies.

JOSEPH AMANN, President
Engineers and Scientists of America

IT HAS BEEN SAID that, "Some companies have three engineering departments – one coming, one going, and one answering their ads." Perhaps this is an exaggeration, but it comes much too near the truth for comfort. For instance, the 1956 average turnover among engineers and scientists in the airframe industry was above 17%. A normal turnover in a stable engineering department is expected to be 2 or 3%. High turnover rates are motivated by low morale, dissatisfaction, and frustration. Frustration and dissatisfaction emerge from lack of professional recognition; working conditions that are not conducive to creative work; too much routine work; lack of security; salary leveling (too little additional pay for added experience and proficiency); and, most important, inadequate pay. As someone wrote to an engineering journal recently, "Whether they be the small Spanish variety or the large Jumbo variety, the fact remains that engineers are still being paid peanuts!"

Since the beginning of World War II, engineering departments have expanded rapidly. As this expansion continues, engineers and scientists find that their special quasi-management status has evaporated. Many of their special privileges and prerogatives are now gone. They are no longer being hired by the man for whom they are to work, but by a professional recruiter. Once on the job, they find they become a number in the personnel file rather than a name.

Personnel policies and salary administration systems are often just "doctored-up" versions of those the company has been using in its machine shop or assembly plant. Sometimes they are not even "doctored-up."

Additional levels of supervisors and "would-be supervisors" are being interposed between the working engineers and the people with real authority. The "open door policy," which most managements espouse, is a complete farce from the standpoint of securing adjustments to grievances or abuses.

Salaries, except for new graduate starting salaries, are not keeping pace with an advancing economy. Experience and proficiency are becoming less and less valuable. In 1939, the average rate for engineers with 10 to 15 years' experience was 2.5 to 3 times the then current starting rate for new graduates. At present, the average rate for 10- to 15-year men is about 1.7 times the current starting rate for new graduates.

There is also a tendency toward intensive specialization in large engineering departments, particularly where the products being developed are complex. In time, this tends to render an engineering job routine, which in turn tends to reduce the individual engineer's desire to develop his technical competence to the limit of his capacity.

There is also the problem of a complete lack of means by which an engineer's technical competence and ultimate capacity can be reliably measured.

Not least in importance is the malutilization which is so prevalent in large engineering departments. A malutilized engineer is a victim of double jeopardy. Not only are his production and earnings reduced at the moment, but the opportunity to broaden his experience and develop his abilities is reduced, which reduces his chances of producing and earning more later on.

Collective bargaining is the only answer because:

- Collective bargaining groups, or unions, are protected by statutes setting forth the ground rules by which bargaining must proceed and by which the union must operate
- Collective bargaining does make effective communication possible – indeed mandatory – since the law stipulates that the representatives of the parties must meet and bargain in good faith
- Through collective bargaining, tools can be provided whereby grievances can be adjusted and abuses eliminated
- Arbitrary and capricious management behavior or management by nepotism and cronyism do not survive where an engineers' union and a healthy collective bargaining situation exist
- Unions generally, and engineers' unions particularly, are equipped to supply themselves with facts and data for collective bargaining purposes far beyond the ability of the individual should he attempt to bargain for himself. Furthermore, the law requires that the company must provide the union with information and salary data pertinent to the collective bargaining process

(continues on page 38)

Engineers?

question may not require an immediate decision, it is thinking. Here, in the pages of INDUSTRY POWER, we controversial subject. What is your opinion? Do you have a third side to this important question? Write your interested in presenting your remarks to all our readers.

HARRY H. RAINS, Attorney
Industrial Relations Counsellor

UNIONS FREQUENTLY promise "pie-in-the-sky" in their solicitation of new members and in their organizational drives. And, like the campaign promises of applicants for political office, such promises must be taken with a grain of salt. Since about only fifteen years ago, when unionization of engineers became apparent as a new phenomenon in the field of labor relations, approximately 10 to 15% of professional engineers in salaried employment have turned to organized labor. Such has been the response to labor's promises, offered as a panacea for the various admitted problems that confront the professional engineer in salaried employment.

Admittedly, management has failed to solve the important problems that stem from industry's sharply accelerated usage and need for engineering and scientific personnel. But before we go any further, let's look at some of the special problems and contradiction of terms posed by professional status for engineers.

It would seem that adherence to their status in a professional calling and membership in a union, as we know it today, is a contradiction in terms and practice. True membership in a learned profession clearly implies the voluntary acceptance of special high standards in work performance. The older professions of law and medicine traditionally carried with them high codes of ethics for the the practitioner and a continuous self-imposed duty to keep up with the advances and new developments in their respective fields. But achievement and maintenance of a true status of professionalism is complicated for the engineer by the simple current fact of large-scale employment on a salaried basis in industry as opposed to the more normal professional independent contract or work performance on a fee basis.

It would seem that a most basic ingredient of true professionalism requires personal development of high standards of work performance and the necessity for satisfying such standards, regardless of whether or not the employer is aware of attainments in work performance, creativity, and continuous self-improvement.

It is common knowledge that the political nature of the union as an institution makes it very difficult, if not impossible, for the union to avoid achieving and catering to the needs of the lowest common denominator. Or at best, the average work performance standards of its members. This factor alone is suffciently grave as to militate importantly against truly significant membership by engineers within union organizations, if the engineer is to remain serious in his desire for attainment and continuance as a member of a learned profession. True attainment of professional status will still lie on the shoulders of the individual engineer, despite the many problems and inequities, management's failures, and malutilization of the engineer.

It is axiomatic and elementary that an engineer who turns to organized labor need not have a multiple basis for his decision. Any one area of management practice or malpractice may be sufficient to drive the concerned engineer into search for relief through the medium of organized labor. Then management's consistent adherence to basic good human relations practices could eliminate a great deal of the dissatisfactions that engineers are finding in their mass employment today. Conversely, the failure to insure consistent practice of good human relation principles on all levels of supervision make the employer the union's most effective organizer.

We may be safe in assuming that engineers are like all other people — perhaps more so. There can be no denying the importance of an appropriate distinguishing job title, the provision for adequate opportunities for growth in terms of job experience, professional training on the job in all its aspects, and opportunities for developing professional skill, knowledge, and close identification with management. Security in the employment status can be implemented by providing adequate means of communication between management and the engineers — in both directions. It is elementary that the engineer, as an employee, should be provided with a means of resolving his individual problems or complaints on the job. Any grievance procedure evolved for the engineer should be tailored to his special needs as a salaried professional employee. But it should be formal enough to enable a

(continues on page 39)

About Harry H. Rains

Harry H. Rains is an attorney who specializes in labor relations as consultant and arbitrator. He was born in 1909 and admitted to the Bar in 1933. He received undergraduate work at New York University and obtained his law degree from Brooklyn Law School. He holds membership in the National Academy of Arbitrators, the American Arbitration Association, the Federal Mediation and Conciliation Service, Panel of Arbitrators, the Industrial Research Association, and The American Institute of Management.

Mr. Rains is executive secretary and labor counsel to many trade associations, and labor attorney for many individual manufacturing companies.

He has conducted several foreman training classes and human relations programs devoted towards the development of effective executive leadership.

He served in World War II, in the various ranks from enlisted man to captain in the United States Army, starting in the Amphibian Engineers and ending as Labor Relations Officer for the Quartermaster Corps in Washington, D. C. and the New York Eastern Region.

At present, he lives with his wife and 13-year old daughter in Old Westbury, N. Y. His hobbies include oil painting, sculpture, sailing, tennis, and golf.

Precise, multistage pressure regulation requirements in 15 buildings of New York's Rockefeller Center provide an acid-test proving ground. Read how . . . .

1500 steam regulators give noiseless, dependable control

ERNEST GRAFE
Field Engineer
Spence Engineering Co.

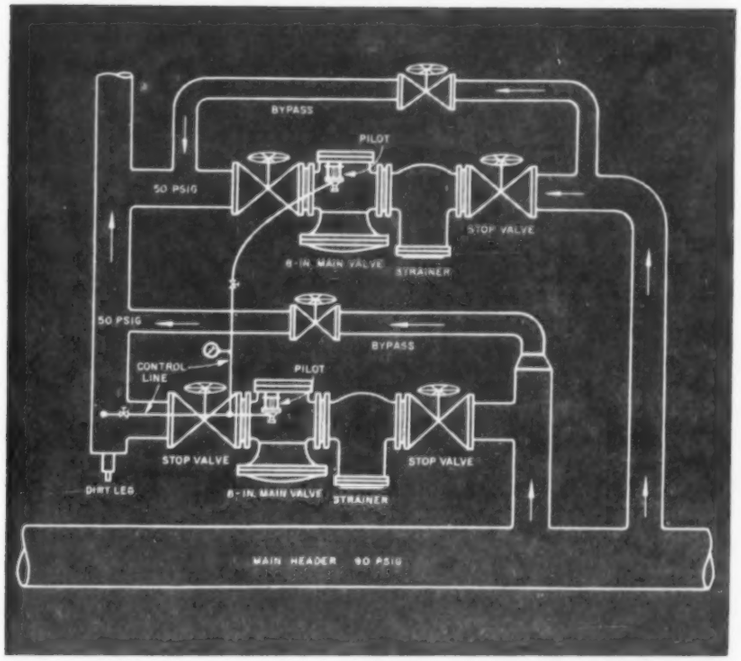
Central control board, in basement of RCA building, pinpoints trouble spots with alarm bells and lights.

MORE THAN 1500 regulators form an integral part of the air-conditioning, heating, and hot-water systems in the 15 buildings of New York's Rockefeller Center. Regulators from 8-in. to ¾-in. dia are installed in hundreds of stations in all buildings from sub-basements to penthouses.

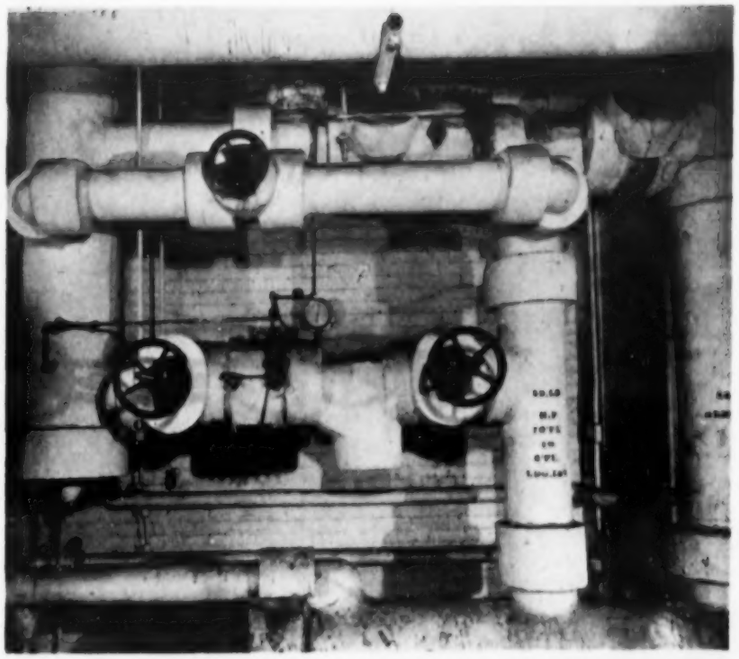
Steam regulation in a prestige group of office buildings such as Rockefeller Center is especially exacting. Many regulator stations are installed in rooms opening directly off corridors used by tenants so that noise levels must be low. Regulator failure due to under-capacity, and possible escape of steam must be kept to an absolute minimum. Steam pressure must be regulated within narrow limits for correct performance of air-conditioning and other equipment. Frequent, routine inspection of all regulators would be expensive, yet uninterrupted, dependable service is required.

To increase dependability and reduce noise level, two-stage rather than single-stage reduction is used. For example, in one air-conditioning machine room, steam at 70 psi is reduced first to 28 psi and then to 5 psi. Two-stage reduction is important in keeping noise low because this station (RCA Building) is next to offices and corridors. Steam at 5 psi is used for preheat and reheat for air conditioning. Closer pressure control is possible with a two-stage reduction than with one.

Steam for the buildings is purchased from New York Steam Cor-



Flow diagram through parallel regulator station. Main header pressure is reduced to 50 psi for use throughout all floors in building.



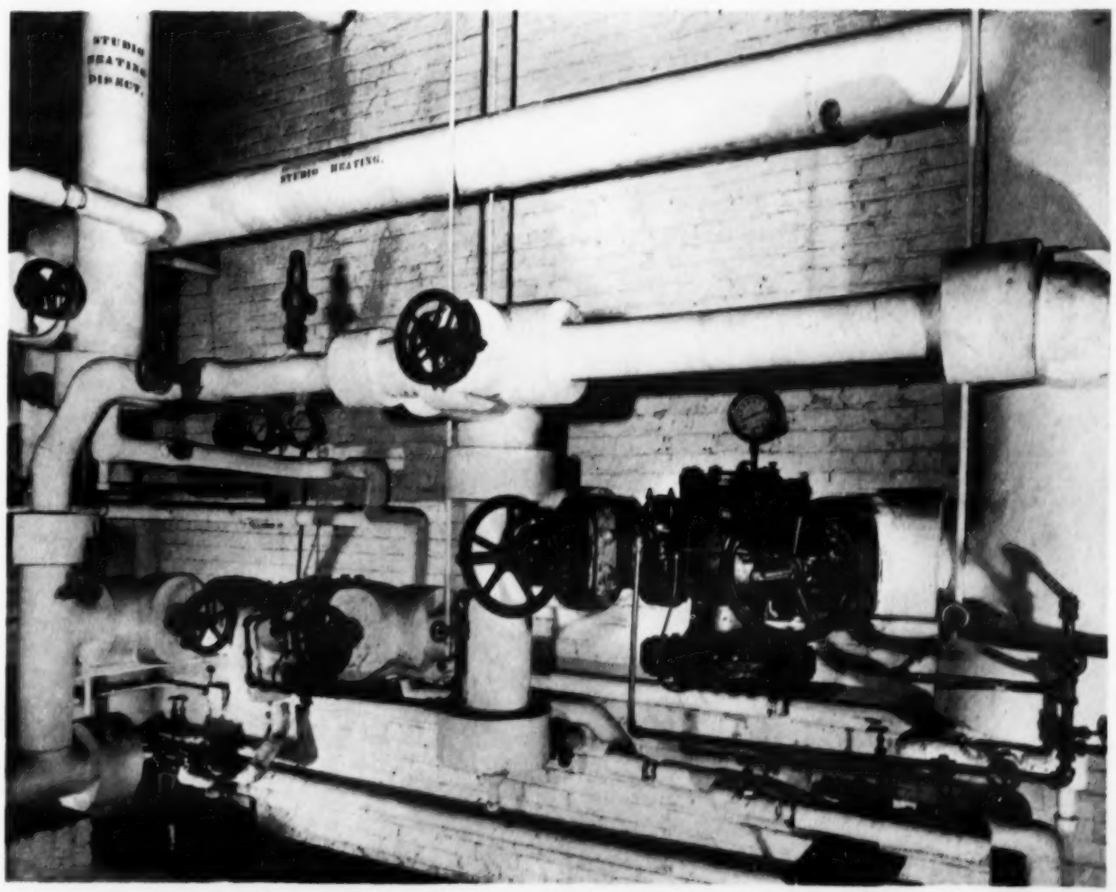
Bottom regulator is sufficient for normal loads. When peak loads occur, upper regulator automatically cuts in to satisfy demands.

poration at 150 psi. Pressure reduction to 50 to 90 psi is accomplished by regulators in the subbasements of each building. Risers take the steam to various floors where steam pressure is reduced, generally in two stages, to 5 to 7 psi. In a few stations, pressure regulation from 0 to 3 psi with a tolerance of ¼ psi is accomplished.

alarm system monitors stations

To exercise constant surveillance over the many regulator stations scattered over the 15 buildings, alarm bells and lights are wired to the secondary pressure gage at the remote stations. If the pressure to a conditioning unit rises or falls more than a specified amount, a bell rings and a light flashes on a central control board in the subbasement. A telephone call sends operator to correct the trouble.

It is not always easy to fit a two-stage reduction station into the available space. Some stations are hung from the ceiling in a room about 10-ft long by 5-ft wide. Steam at 90 psi from a 6-in. riser toward the rear of the room is reduced to 50 psi through a 1¼-in. regulator and to 7 psi through a 1½-in. regulator. To have required pipe length for good operation, inlet steam makes three trips the length of the room before reaching outlet. *(continues on page 21)*



This two-stage pressure-reducing station controls steam for heating radio and TV studios. First stage reduces the main header pressure from 90 to 20 psi. Second stage reduces from 20 psi to vertical riser pressure of 7½ psi.

Pennsylvania Power & Light Company
investigated several coatings
before they decided to . . . .

Fight corrosion with zinc-rich paint

JOSEPH V. FERDINAND
Chief of Laboratory
Pennsylvania Power & Light Co.

Riveted steel surge tank at Wallenpaupack plant near Hawley, Pa. is 130-ft high, 55-ft dia.

HIGH COST OF CORROSION is a particularly troublesome problem in hydroelectric plants where large areas of steel surface are in constant contact with water. To minimize deterioration and maintain optimum performance and maximum service life, the Pennsylvania Power & Light Company made a thorough investigation. As a result, a preventive maintenance program is in operation that relies heavily on using metallic zinc dust and zinc-rich coatings on wetted or exposed steel surfaces.

Wallenpaupack Hydroelectric Station at Hawley, Pa. — a peak load power plant — generates electric power that is boosted to 66,000 and 220,000 volts for transmission.

Water is tapped from Lake Wallenpaupack and carried through a 14-ft dia flow line for about 3¼ miles.

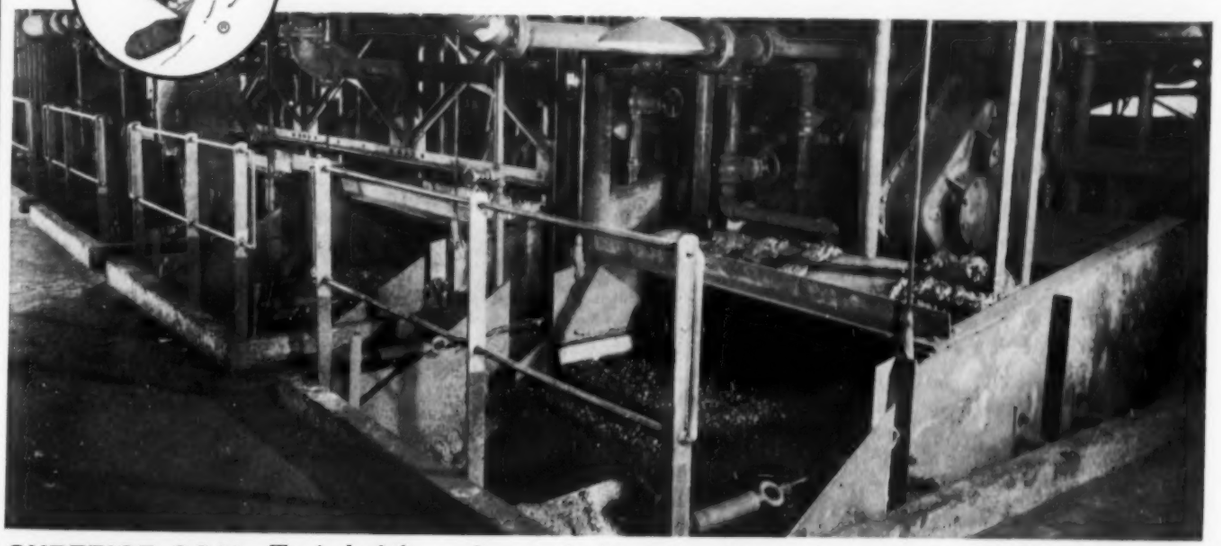
Water from the flow line feeds into a differential surge tank that consists of an inner tube located concentrically in a larger outer shell. Two penstocks lead from the surge tank to two hydraulic turbines in the plant.

Differential tube dampens the effect of rapid surges in water flow to avoid possible damage to the system. Constructed of circular steel sections riveted together, the 130-ft high differential tube tapers from an 11-ft dia at the base to 8-ft dia at

(continues on page 40)

Sheet steel flow line, 14-ft dia, is part of 3-mile conduit from lake to hydroelectric plant.

WHY CHESSIE'S RAILWAY IS FIRST IN COAL



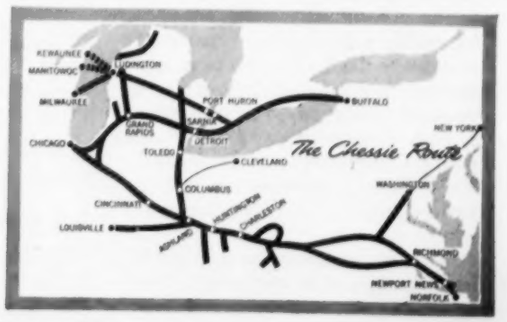
SUPERIOR COAL. Typical of the modern methods employed by producers on the C & O is this battery of screens de-watering washed coal. The naturally superior coals found in the Chessie area can be sized and processed to suit your exact requirements.

SUPERIOR SERVICE. Chesapeake and Ohio Railway is equipped to give you prompt and dependable deliveries through expanded high-speed yards and improved signal systems. There are plenty of good-order cars in the world's largest fleet. A prompt repair program keeps 99% of the C & O cars in constant operation.

For dependable deliveries of top quality coals, contact coal producers on the C & O. And for specific help in meeting your own fuel requirements, write to: R. C. Riedinger, General Coal Traffic Manager, Chesapeake and Ohio Railway Co., Terminal Tower, Cleveland 1, Ohio.

Chesapeake and Ohio Railway

WORLD'S LARGEST CARRIER OF BITUMINOUS COAL

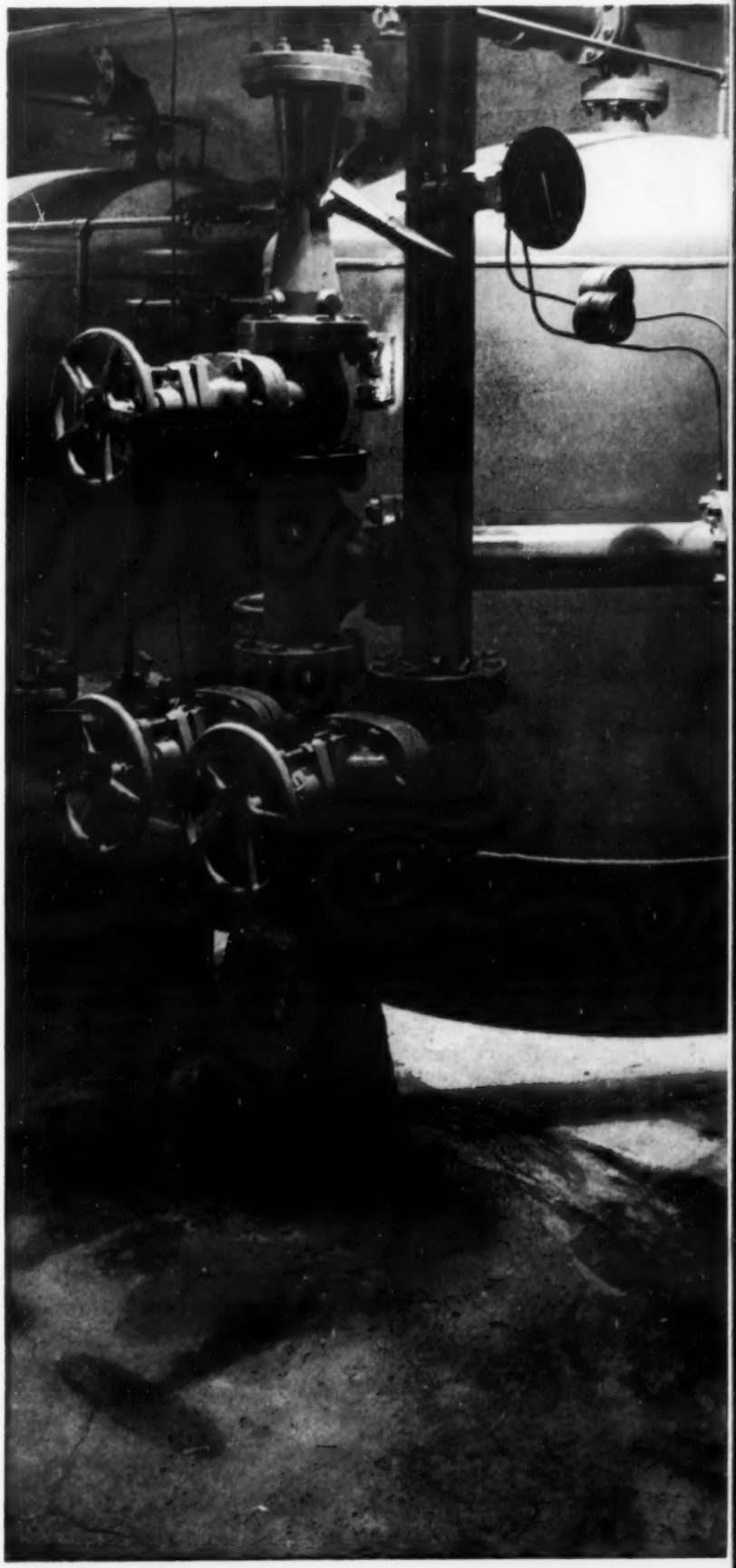


Circle 124 on READ-N-CIRCLE card for more data

Selecting the correct centrifugal pump is just the first step in efficient operation. To maintain continued economic operation . . . .

Check *your* centrifugal pumps

EUGENE L. BROOKS
Assistant Chief Engineer
The Deming Company



RESPONSIBLE MANAGEMENT of the maintenance program prolongs service life of equipment and reduces operating costs. Centrifugal pumps are no exception. Here are some check points.

follow this general procedure

When starting pump, considerable leakage should be allowed. Overheating should be prevented, as this will melt lubricant out of the packing. After sufficient wearing-in time (usually from one to two hours), packing will have formed a correct seal around the shaft. Temperature will be within safe limits and leakage not excessive.

Many pump manufacturers use bulk packing to prevent scoring pump shafts. This packing is a mixture of lead, cellulose, and graphite. In one automobile assembly plant, this packing has increased pump operation from 90 days to 1 year before maintenance.

Mechanical seals are often used instead of a packed stuffing box. Mechanical seals have not proven successful for gritty or non-lubricating fluids. Mechanical seals are not yet accepted as a substitute for packing in all cases. For circulating costly solutions, most practical solution is the installation of a submerged pump, which requires no stuffing box. Another advantage is that no extra floor space or expensive foundations are needed. These compact pumps use only a small space on the circulating-tank cover.

Bearing maintenance is a problem common to most pumps. Two bearing types most frequently used are sleeve and ball bearings. Sleeve bearings are close to the impeller and are submerged in the liquid being pumped. If liquid is free of gritty particles, it provides lubrication between the pump shaft and bearing surface.

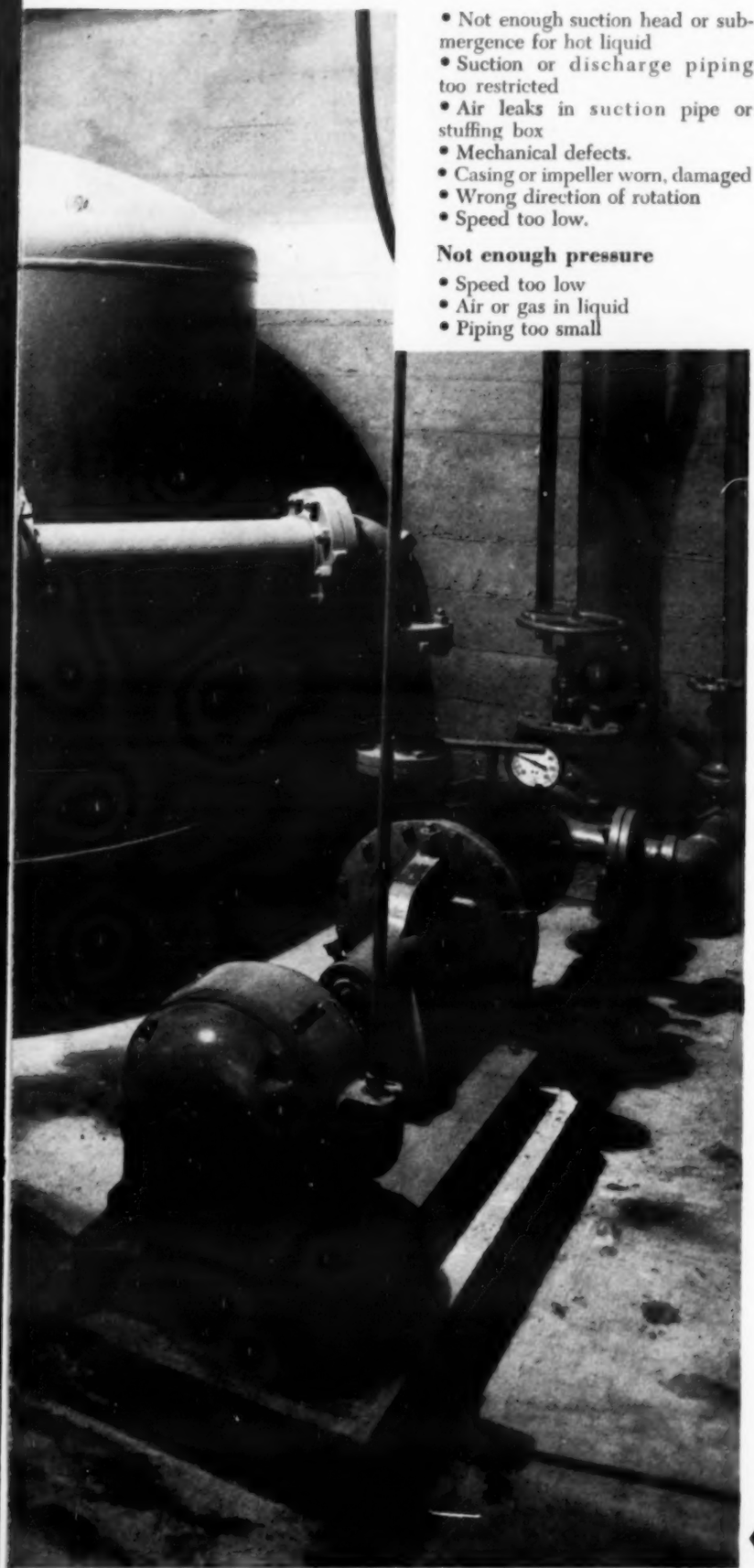
If the pumped liquid is not clean, however, clean water is piped to the sleeve bearing center. This water is maintained at a pressure higher than the head dedeveloped by the impeller. Water lubricates the bearing and excludes any gritty particles. Pump manufacturers are replacing sleeve bearings with ball bearings in most new equipment. Two main problems with ball-bearing maintenance are: keeping out water or corrosive solution, and proper, *but not surplus* lubrication. Actually, surplus grease prevents correct heat dissipation from the bearing. Most pump manufacturers include instructions for proper bearing lubrication with each pump. No general rule covers bearing lubrication for every use. But regular bearing inspection should be a part of standard pump maintenance.

When centrifugal pump performance drops below requirements, the pump must be repaired to assure that output meets demand. Many poor performance symptoms can be remedied without an overhaul.

how to locate pump troubles

Not enough liquid delivered

- Discharge head requirements higher than anticipated
- Suction lift to high



- Not enough suction head or submergence for hot liquid
- Suction or discharge piping too restricted
- Air leaks in suction pipe or stuffing box
- Mechanical defects.
- Casing or impeller worn, damaged
- Wrong direction of rotation
- Speed too low.

Not enough pressure

- Speed too low
- Air or gas in liquid
- Piping too small
- Impeller diameter too small.

Pump works for a time and then quits

- Leaking suction line
- Water seal plugged
- Suction lift too high
- Not enough submergence
- Air or gas in liquid.

Pump takes too much power

- Speed too high
- Head lower than rating, pumps too much liquid
- Liquid either more viscous or heavier than anticipated
- Mechanical defects
  Shaft bent
  Impeller binds in casing
- Stuffing-box packing too tight.

Where inspection indicates that worn centrifugal pump parts are causing reduced performance, a pump overhaul should be performed. A regular procedure should be followed:

FIRST. Remove ball bearings from the shaft and wash with clean kerosene. If inspection shows that they are still usable, coat with oil and wrap in clean rags or paper until reinstalled on shaft.

SECOND. Inspect shaft and sleeves (if any) for wear and scratches where shaft passes through packing. Shallow scratches can be removed by polishing or grinding. Deep scratches and grooves call for new parts.

THIRD. Thoroughly inspected impeller and casing.

To properly inspect and refit impellers, it is necessary to recognize the features of impellers used in centrifugal pumps.

Some impeller vanes produce a wiping action on the casing face. This impeller is preferred for fluids containing solids. Centrifugal pumps with semi-open impeller and volute casing are used frequently for pumping clear or muddy water and brine at discharge heads up to 75 psig. Other types are used for clear liquids.

pump pressure is sealed by several methods

Pressure developed by the impeller is sealed in different ways. Some designs incorporate wear rings that fit closely in the casing. Others seal the pump discharge space from the suction space in an axial direction by letting impeller vanes rotate close to the casing wall

This 3-inch Deming centrifugal pump circulates 122,000 gal through pressure filter in 8 hrs.

Impeller seal consists of impeller wear ring rotating in casing with clearance. If this clearance is over 0.005 to 0.010 inches on small- and medium-size pumps, new parts should be installed. The front clearance should be between 0.002 and 0.005 inches. This clearance can be varied by moving the impeller, provided axial adjustment is possible in the bearings.

When there is excessive clearance between impeller and casing, a large part of the pumped liquid bypasses the impeller. Output and efficiency are greatly impaired. Adjustment procedure is simple and trained plant personnel can make the change. For best results, the adjustment should be made while the pump is running.

All ball bearings (except for special applications) have a certain amount of end play. When pump is operating under load, the shaft will shift its operating center a few thousandths of an inch one way or the other. With a pressure gage and instruments for measuring power consumption, the best operating setting can be determined. Enlarged clearances resulting from impeller vane or casing-face wear, or both, can be reduced by impeller readjustment.

When pump delivery exceeds requirements, adjustment can be made by partial bypassing. This method of reducing capacity is less detrimental to efficiency than customary throttling by valves located in discharge line.

alignment faults can cause excess wear

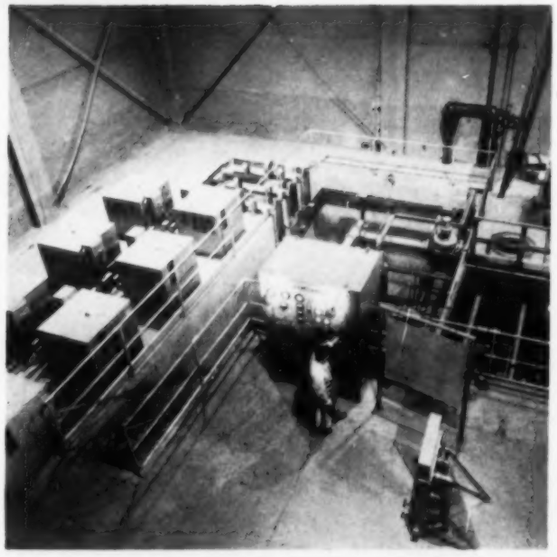
After pump has been refitted and reinstalled, alignment should be rechecked before starting unit. Pump operation with poor alignment causes undue coupling wear as well as bearing wear in both pump and motor. Alignment inspection procedure should be a part of regular pump maintenance. When perfectly aligned, pump rotating element should turn freely without binding and should show no tight spots.

Pump manufacturers produce centrifugal pumps for industrial applications with cooperation from maintenance men throughout all industry. Engineers work constantly to develop better pump designs to increase operating efficiencies and lower operating costs. Benefits of their experience and studies can be fully realized only when responsible management carries out thorough operating and maintenance programs. ◆◆

Photo News

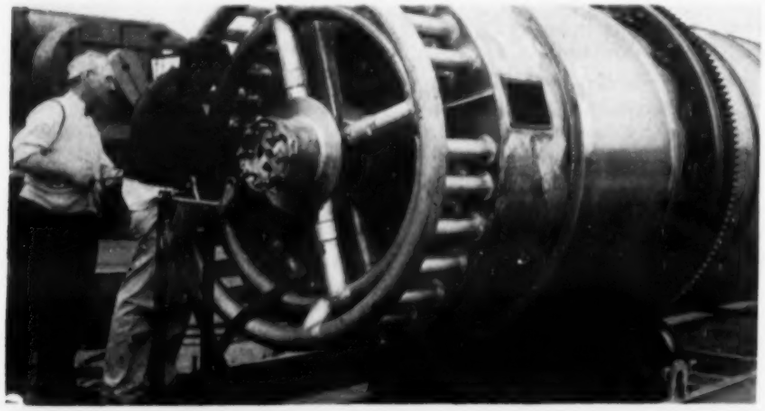
ELECTRICAL INDUSTRY'S efforts to "locate, preserve and encourage public display of historical electrical equipment" moves ahead by establishing Electrical Historical Foundation. Photo (left) shows trustees, meeting at Burndy Library, Norwalk, Conn., viewing some of its historical material. Cabinet on table holds Nairne electric machine built in 1773. Library director Bern Dibner, left, explains exhibits to (left to right) Julian K. Sprague, Sprague Electric Co., Dr. S. G. Hibben, Holophane Corp., Dr. Erich Hausmann, dean emeritus, Brooklyn Polytechnic Institute, E. S. Lincoln, consulting electrical engineer, and H. E. Kent, Edison Electric Institute.

TECHNICIANS CHECK over new core for North Carolina State College reactor. Recently manufactured by Atomics International, core uses uranium salt in solution as fissioning fuel. Fuel was selected because of its inherent safety and ease of operation. Reactor is used at Carolina college for training programs in nuclear engineering and physics.

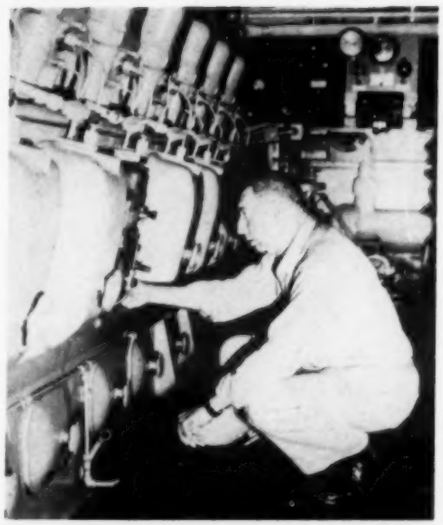


NEW 16-IN. dia vacuum arc furnace is now in use for production melting of molybdenum and molybdenum alloys at Universal Cylops Steel Corp. Bridgeville, Pa., plant. At left of photo, ten selenium rectifiers produce power supply of 15,400 amperes. Designed and built by General Electric Co. Industrial Heating Dept., furnace casts an extremely pure ingot.

ALL-WELDED ALUMINUM construction is featured in this steam-tube dryer, one of two built by Standard Steel Corp., Los Angeles, Calif. for the Fluor Corp., Ltd. Ultimate installation will be in low-pressure polyethylene plant of Polymer Chemicals Div. Baton Rouge, La. plant.



FIRST MARINE engines with overhung generators are feature of U. S. Navy's new Arctic tanker, USNS ALATNA. Generators are bolted directly to engine, have no independent support. Here Chief Engineer P. H. Monahan checks fuel pump on one of the two ALCO 16-cylinder diesel engines installed on the vessel.



1500 regulators

. . . starts on page 14

Flexibility is another requirement at Rockefeller Center. For example, there are several large stations in the sub-basement of the 70-story RCA Building. In some cases, parallel reduction stations are required. Steam enters the horizontal header at 90 psi and flows up a short riser. Two 8-inch regulators are installed between the short riser and the riser that extends up into the building. Steam pressure in the main riser is 50 psi. This reduction can be made safely and efficiently in one stage because the drop is less than ½ the original pressure and the reduced pressure is more than 20 psi.

Noise problem is not critical in the sub-basement and personnel traffic is light. The lower bottom regulator takes the main load, but on increased demand, the upper regulator cuts in automatically to increase steam flow into the riser and to maintain required pressure. Control lines of the two main valves are inter-connected. When pressure in the riser drops slightly because of increased demand, the second regulator immediately opens and increases steam flow. In case either regulator fails, the other one can handle the load while repairs are effected.

With the great number of regulators in service, it is an advantage to standardize on one kind. Rockefeller Center has standardized almost entirely on the type ED regulator manufactured by Spence Engineering Company, Inc.

Although many different sizes of main valves are used, (from 8-in. down to ¾-in.) pressure pilots that control main valve action are all the same and are completely interchangeable.

interchangeable points decrease inventory

Pilot from an 8-in. main valve can be, and often is mounted on a ¾-in. (or any other size) valve. Only spring compression on the pilot need be changed to meet the new pressure conditions. Sometimes the spring itself must be changed. This results in a minimum inventory of pilots and spare parts to service hundreds of regulators.

Air-conditioning equipment is being installed to provide new conditioning facilities as well as to increase capacity to satisfy heavier loads. Regulator stations are constantly being removed and replaced with larger ones.

Each station is equipped in accordance with approved engineering practices. Each has a strainer ahead of the regulators to prevent dirt, rust particles, and other solids from fouling the pilots and main valves. Each station can be isolated from the main steam line for inspection and maintenance, with a bypass to permit steam flow to heating and air-conditioning equipment while the regulator station is isolated. Many larger stations have dirt legs and condensate traps. Pressure gages on the down-stream side of each regulator permits accurate pilot settings during initial operation. Also, existing pressure can be determined at any time.

performance records are not necessary

Records of pilot or main valve performance are not kept. Value of such records is not commensurate with the cost of setting them up. With well-designed stations, records or a routine maintenance system have not been necessary. Many larger valves have been in operation since the first buildings were erected in 1933. ◆◆

confused . . .

about the loudly claimed Engineering shortage? The smokescreen of verbal and written matter on this subject is enough to confuse anyone. But we, the Editors of Industry Power, are doing something to pierce this smog of confusion.

We are conducting a nationwide survey to find the opinions of the man most concerned — YOU. The results of our survey will be presented soon.

Watch for . . . .

Industry Power's

Engineering Shortage Survey

FRAMELESS

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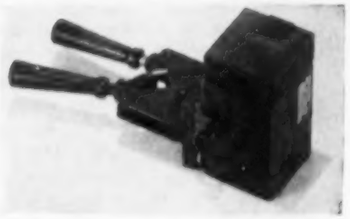
Eliminates All Frames



NEW E-Z CHANGE Handle Clamp fits directly into graphite mold — simplifies your equipment for making CADWELD Electrical Connections.

IN LESS THAN 3 SECONDS — change from one mold type to another.

DRASTICALLY REDUCES INVENTORY COSTS — E-Z CHANGE Handle Clamps are manufactured in just two sizes (one for 3" molds — one for 4" molds). One of each size will handle 95% of all types of STANDARD CADWELD Connections.

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POWER BASICS FOR TODAY'S INDUSTRY

Fluid mechanics — II

Fluid statics and kinematics

This series of articles is not intended as a text — rather its purpose is to cover the basic principles and formulas in easy-to-read style for those who have been away from the subject for some time. The separate parts will be reprinted in pocket-size booklet form (similar to our other Power Basics booklets) when the series is completed.

PROFESSOR JAMES M. ROBERTSON
Theoretical and Applied Mechanics
University of Illinois

FLUID MECHANICS is essentially a dynamic subject, for we are interested primarily in fluid motion and the resultant pressures or forces. Static and kinematic factors are usually of little direct interest, but to understand and utilize our dynamic analysis methods (primarily Bernoulli's Theorem) we must be sure we comprehend these basic factors. An understanding of fluid statics is basic to proper determination of pressure in fluids, and this is one of the important terms entering into Bernoulli's Theorem. Kinematic considerations must be used to determine the velocities to be inserted into Bernoulli's Theorem or into the momentum relation.

Pressure is defined as a normal force per unit area, i.e. a normal stress. We usually consider pressure to be independent of the orientation of the area upon which it acts. This condition of isotropy, known as Pascal's Law, is strictly true only for cases in which the effect of viscosity is negligible or in which there is no flow. However, such effects are not usually large and we shall ignore them. In the foot, pound, second system, pressure units are lb/ft² (psf), although we more commonly use lb/in² (psi) since it is numerically smaller.

Besides having several common units for pressure measurement, we have two reference systems. It is important, therefore, to keep clear about which units and which reference system we are using. Inconsistencies in this regard will lead to errors.

Pressures are referred to either an absolute or a gage datum. The reason for having two reference systems is apparent when we realize that all our pressure measuring devices indicate pressure differences. Thus, the usual pressure gage indicates the difference between the pressure surrounding it and pressure in the line to which it is connected. Since the ambient pressure about a gage is usually atmospheric, we commonly measure "gage pressures" (psfg or psig), referenced to atmospheric pressure. Absolute pressures (psfa or psia) are referred to the datum of absolute zero pressure. Absolute pressures must be used when dealing with properties of gases or vapors, as in the equation of state. In fluid mechanics, it seldom matters if we use absolute or gage pressures, as long as we are consistent.

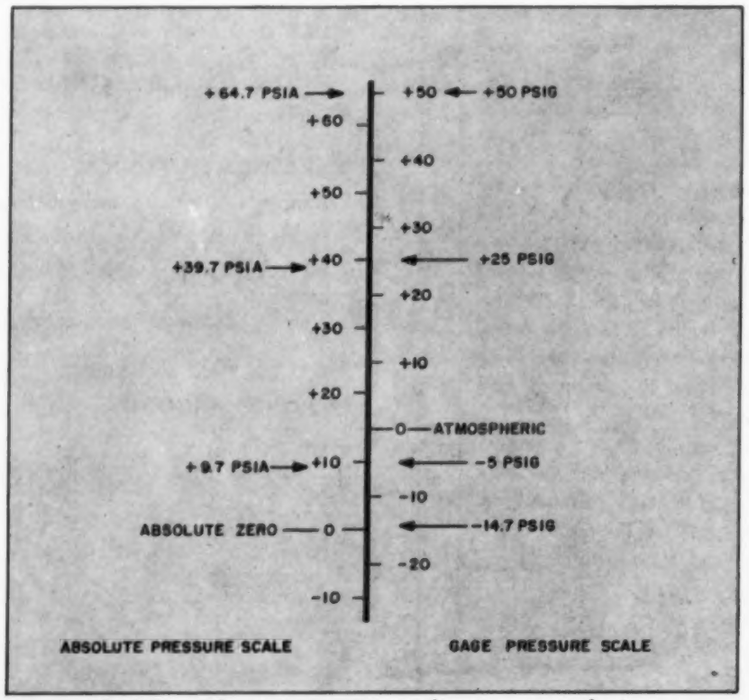


Fig. 1—Absolute and gage pressure scales for atmospheric pressure.

Atmospheric pressure varies over the surface of the earth due to elevation and weather changes. These variations are normally not large and we speak of a standard atmospheric pressure of 14.7 psi. When this applies, the relation between the two reference systems is

$$\text{psia} = \text{psig} + 14.7 \qquad (1)$$

This is illustrated in Fig. 1. In Denver, for example, where the altitude is about a mile above sea level, atmospheric pressure is only about 12.2 psi. The constant in Eq. 1 and the difference in scales in Fig. 1 for Denver is thus 12.2.

In many situations, pressure variation in fluids is hydrostatic. Such a variation is basic to pressure measurement. Pressure difference between any two points at elevations Z_1 and Z_2 is then given by the equation

$$p_2 - p_1 = \gamma (Z_2 - Z_1) \qquad (2)$$

where γ = specific weight (lb/ft³)
In a liquid, if h (ft) is the distance below the free surface, Eq. 2 reduces to the simple relationship

$$p = \gamma h \qquad (3)$$

When pressure above the liquid

surface is atmospheric and conventional units are used for γ and for h, p in Eq. 3 is in psfg.

Application of the hydrostatic pressure relationship (Eq. 2) to gases is appropriate as long as the pressure changes are so small that specific weight may be regarded as a constant. For air, an elevation change of about 400 feet changes γ by 1% from its standard value.

We have said that all our devices for pressure measurement are differential devices – they measure the difference between two pressures. Even the barometer, whether mercury or aneroid type, only measures a relative pressure. In this case, however, the reference is a very low pressure – nearly absolute zero. Pressure at the top of a mercury barometer approaches the vapor pressure of mercury, which is 0.000025 psia.

One of the most common devices for pressure measurement is the Bourdon-tube pressure gage. This is nothing but a flattened tube, bent in the form of a circle (Fig. 3). Pressure inside the tube tends to straighten it out, driving the pointer around the scale. Gage action depends upon the difference in pressure between the inside and outside of the tube. Usually, pressure outside the tube is atmospheric, but Bourdon gages have been made to indicate the difference in two arbitrary pressures, by pressurizing the case surrounding the tube and mechanism.

Another common device for pressure measurement is the differential or U-tube manometer (Fig. 3). This may be a single bent piece of glass, a multitube manometer, or a draft gage – the principal of operation is the same. By using a gage fluid of different specific gravity from that of the fluid whose pressure is to be measured, the difference in elevation of the gage fluid in the two legs of the manometer indicates the pressure difference. In some cases, one leg is much larger in cross section than the other to form a pot in which the liquid remains at practically the same elevation despite pressure variation. Pressure is then indicated solely by elevation of the fluid in the thinner leg. In a draft gage (Fig. 3), this leg is inclined to spread out the reading and increase accuracy.

Interpretation of manometer or draft gage indications involves the successive application of Eq. 2 to each length of different fluid occurring between the two points where pressure is to be determined.

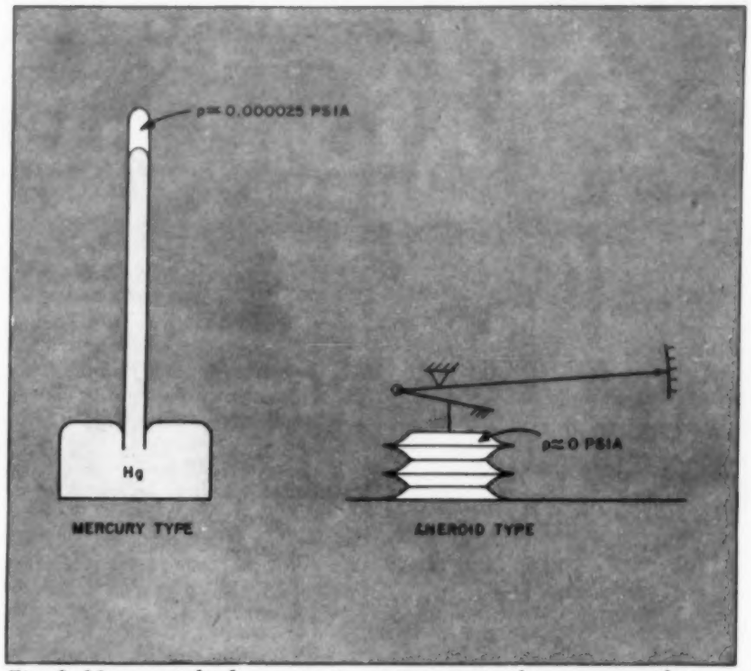


Fig. 2–Mercury tube barometer is more accurate than an aneroid type.

This is best accomplished by writing a *manometer equation*. We start at one end of the tubing connecting the two points and proceed along the tubing to the other point. Whenever the line descends we add the increment indicated by Eq. 2; whenever it rises we subtract. Short cuts in this approach often appear, but there is only one that is safe to take. When two points at the same elevation are separated by a U-shaped tube containing only one fluid without a break, then one may assume that the two points are at the same pressure.

EXAMPLE: Two pipes (or two points in the same pipeline some distance apart) contain water and are connected by tubing and a manometer (Fig. 4, page 43). What is the difference in pressure between points A and B?

SOLUTION: We first note the fluid specific weights.

$\gamma_w = 62.4$ lbs/ft^3 for water

$\gamma_c = 1.59 \times 62.4$
$= 97.7$ lbs/ft^3
for carbon tetrachloride

$\gamma_a = 0.076$ lbs/ft^3 for air (assuming it is under a pressure not greatly different for standard)

We then write our manometer equation, starting with point A, making sure to express all distances in feet,

$$p_A + \frac{10}{12} \times 62.4 - \frac{6}{12} \times 97.7 + \frac{3}{12} \times 0.076 - \frac{8}{12} \times 97.7 - \frac{2}{12} \times 62.4 = p_B$$

$$p_A + 52.0 - 48.8 + 0.02 - 65.2 - 10.4 = p_B$$

$p_A - p_B = 72.4$ psf or 0.50 psi

It is apparent that even if air density were ten times that assumed, its effect would be negligible.

pressure determination complex in moving fluid

When a fluid is moving, accurate pressure determination is more complicated than in the static case. We cannot just place an open tube into the flow and read the pressure at the other end. The difficulty is most easily apparent if we consider Bernoulli's Theorem, the fundamental relation for flowing fluids. We have already noted that this theorem relates pressure, elevation, and velocity at one point with those at another point in a flowing fluid.

$$\frac{p_1}{\gamma} + Z_1 + \frac{V_1^2}{2g} = \frac{p_2}{\gamma} + Z_2 + \frac{V_2^2}{2g} \qquad (4)$$

Comparison shows that Eq. 2 is nothing but Eq. 4 for the special case of zero velocity. From Eq. 4, it is apparent that to properly determine p we must insure that velocity is not disturbed at the point of measurement. This is not easy, even when we wish to measure pressure along a wall. In such cases a piezometer hole is drilled

(continues on page 43)

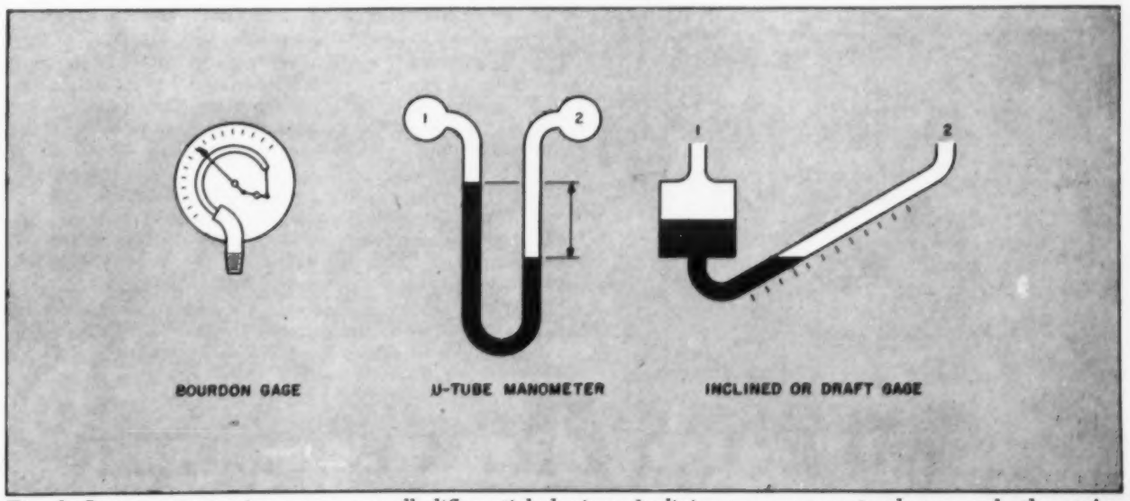
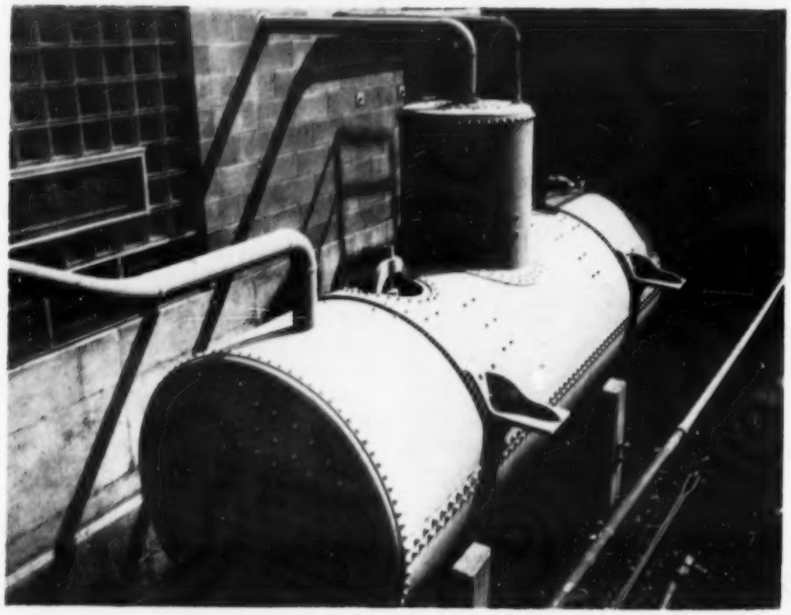


Fig. 3–Pressure measuring gages are all differential devices. Inclining one manometer leg spreads the scale.

Marathon Corp. engineers, using salvaged equipment, save money by converting this . . . .

Locomotive BOILER to AIR RECEIVER



In new role, locomotive boiler is a functional air receiver that can be installed for minimum expense.

SHARP EYES FOR SALVAGE can save money for you as they have for Marathon Corp. at their Rothschild mill.

Marathon needed an air receiver for the mill's compressed air system. Their powerhouse engineer discovered a serviceable fire-tube locomotive boiler in a nearby scrap yard.

For use as an air receiver, boiler had to operate with compressed air at 90 psig, which is the Rothschild mill's system pressure. Marathon called in its insurance company's boiler inspector. Tests, under his supervision, showed a 200% safety factor.

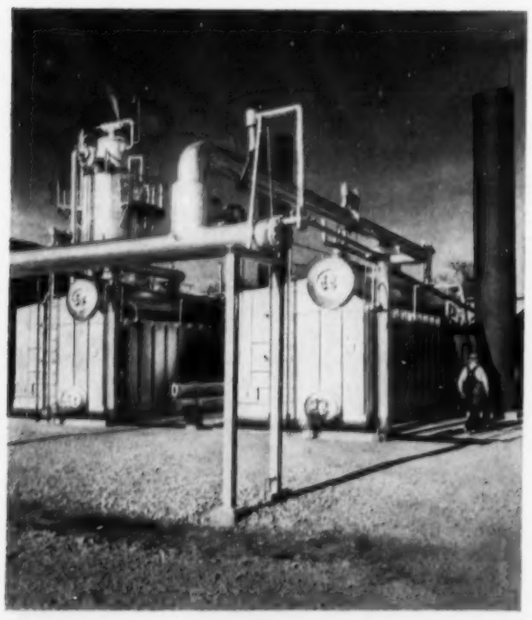
Locomotive boiler was brought to the plant and installed in the yard, just outside plant air compressor room. It was then connected as an air receiver. Compressed air is pumped from a 200-hp, 1100-cfm Worthington compressor to the locomotive air receiver. Compressed air is fed from receiver to plant system.

Marathon engineers installed a 3-inch relief valve set at 115 psig on the locomotive air receiver. A similar relief valve is installed on the compressor. Smaller relief valves are installed at various points throughout the plant compressed air system to comply with safety regulations.

Out-of-pocket expense was limited to the small amount required to purchase boiler and relief valves.

Money-saving possibilities in salvage equipment are clearly demonstrated in this ingenious application by Marathon's sharp-eyed engineers. ♦ ♦

PACKAGED STEAM by FW



helps load more than 7,000,000 gallons of oil in less than 3 months

When U. S. refiners recently were required to meet a sudden, extended demand from Europe for oil, one of the key points of supply was the Magpetco Terminal of Magnolia Petroleum Company. With storage capacity for some 4½ million bbl of petroleum products, this southeastern Texas tank farm was a "natural" for emergency use as a crude oil outlet point—7,000,000 gallons of crude oil were loaded in less than 3 months.

The two Foster Wheeler Packaged Steam Generators shown at left not only met all the normal load requirements but demonstrated ample reserve capacity for emergencies. They provided a reliable source of steam which was essential to operate the many large reciprocating pumps and to heat heavier oil in the storage tanks to facilitate pumping.

Chosen by Magnolia engineers to replace outmoded steam equipment at the terminal, the units are installed outdoors. Casings are of all steel welded construction with weather proof insulation over the drum ends. Each unit delivers 30,000 lb of steam per hour at 150 psi. Dimensions are: 10′ x 28½′ x 12′ high.

FW Packaged Steam Generators are available in capacities from 10,000 to 62,500 lb/hr and pressures to 1300 psi. For complete information, send for Bulletin No. PG-55-3. *Foster Wheeler Corporation, 165 Broadway, New York 6, N. Y.*

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The Editor
INDUSTRY POWER
St. Joseph, Michigan

new products

700-Insulation tester has 4-position switch

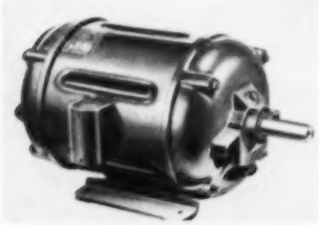
Meg type Megger insulation testers now have 4-position switch to provide versatility lacking on hand-operated generator models. Tester includes ratio switch permitting measurement of insulation resistance in normal range of 0 to 1000 megohms and also range of 0 to 100 megohms for measurements test because test voltage is dc.

Added safety is assured with instrument's ability to discharge capacitance without hazard to persons or equipment that might come in contact with charged apparatus following tests. Charge is dissipated without harm to apparatus or tester when discharge switch is thrown. This

down as low as 10,000 ohms (made by dividing by 10 the regular megohm scale). Discharge switch permits discharge of capacitance in apparatus under test. Charge is built up during opens circuit between measuring portion of instrument and testing terminals, short-circuiting the latter through a current-limiting resistor. James G. Biddle Co.

701-New ratings for single-phase motors

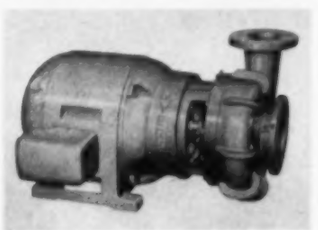
Repulsion-start induction single-phase motors in integral horsepower 4-pole ratings 1



through 5 hp are now available in NEMA frames 182 through 254U. New frames makes motors interchangeable with capacitor-start and small polyphase motors of the same ratings. Wagner Electric Corp.

702-Centrifugal pumps for heavy duty pumping

High capacity, high head centrifugal pumps for conditions requiring extremely high gallonage and pressure may be motor-mounted, direct-connected, or



belt-driven. Capacities range from 200 to 1500 gpm at heads to 340 feet. The F. E. Myers & Bro. Co.

(continues on page 26)

PICK THIS PUMP
for reliability and maintenance economy...

CROSS HEAD is oversized, running in carefully machined guide—preventing usual pump failures at this point. All moving parts and packing can be removed without breaking piping connections.

LIQUID ENDS: Valves are machined from solid stainless steel. No pressed seats to work loose. Valve balls are hardened and ground, and stainless steel spring-loading insures instant response, even on viscous liquids and slurries.

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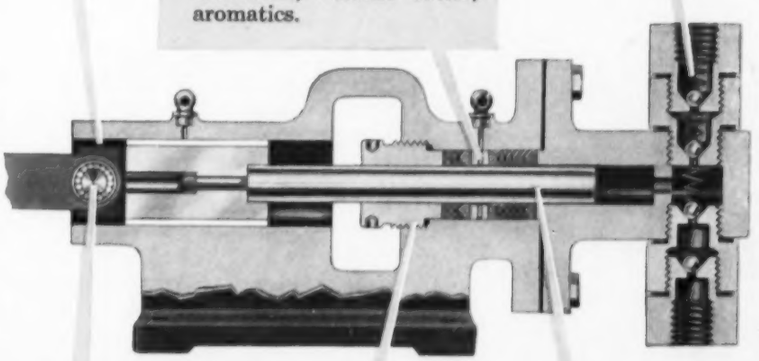

CONNECTING ROD BEARINGS—hardened and ground pins running in grease lubricated needle bearings, replace the usual rapidly-wearing bronze bushings.

PISTONS are stainless steel, ground and polished. Accurate capacity control is obtained by piston stroke length adjustment. Adaptable to both manual control and instrumentation.

PACKING GLANDS are easily accessible at both ends to simplify packing replacement. Gland take-up is a screwed nut, insuring even pressure on packing—no cocking, less packing trouble.

For more facts about Philadelphia type S Pumps — for 85% of all chemical pumping needs — write for Bulletin S-1254.

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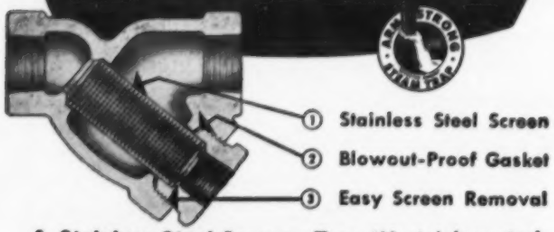

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new products

... starts on page 25

703-Self-fusing electric tape is cable insulation plus sheath

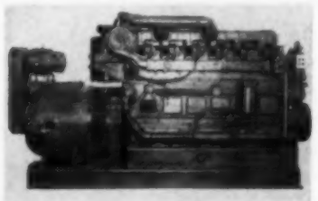
Okoweld self-fusing tape is Underwriters' Laboratories approved for joints and splices in electric conductors. Serves both as insulation and sheath on cables operating at 200 volts. Okoweld resists effects of weather, chemicals, flames, or mechanical abuse. Another safety feature—it is available in five colors for phase and circuit color-coding. Okoweld can be wrapped using a tension up to a maximum drawdown of ¾ normal width. Since all surfaces are bonding, no care need be given to which side of the tape is up or down. Conforms readily to irregular surfaces and shapes—adheres to either plastic or rubber cables. Okoweld is 30 mils thick (± 3 mils); tensile strength is 250 psi minimum; elongation is 300% minimum. Each thickness has dielectric strength of 15,000 volts. The Okonite Co.

704-Install new roof on top of old one

Vulca-dek process permits installation of new roof over the old one, cutting cost of roof replacement by up to 55%. Process eliminates heating roof coating and hot mop applications. Hold-Tite plastic sealing cement gains extra adhesiveness from new ingredients. Felt plies are bonded firmly together and new felt adheres firmly. Siliconed sealer is then spread over felt. The Monroe Co., Inc.

705-Slow-speed engine with high hp

LRT-6 Turbodiesel engine meets high horsepower, high torque engine requirements for heavy duty industrial applications. LRT-6 is six-cylinder engine with T-590 turbocharger and pressure-time fuel system that uses variable pressure to meter fuel charge. Engine develops 450 hp at 1100 rpm and has displacement of 2477 cu in. Cummins Engine Co., Inc.



(continues on page 31)

what's so strange . . . .

about our willingness to send you INDUSTRY POWER without demand of a token subscription fee? Nothing, really. You see, no publisher of industrial magazines breaks even on subscription revenue . . . . not after he's paid out the costs of getting that revenue. (Why, then, are there any "paid" magazines? Because the "paid" designation permits mailing at cheaper, second-class rates than is possible for "controlled-circulation" magazines, such as INDUSTRY POWER.)

We prefer to hand-pick the men who will receive INDUSTRY POWER (see qualification form on the reverse side of this card) on the basis of continuing research that tells us who are the important men that work in the field our editors and advertisers serve. By selective hand-picking, rather than by extracting a token fee from anyone who might be susceptible to a subscription pitch, we can be sure that we reach the men who matter most in managing the Power Services. Is that so strange?

The Editors

P.S. Many "paid" magazines have substantial "controlled" circulation . . . . up to 30 percent is permitted by postal regulation. And many publishers of "paid" magazines have "controlled" magazines in their stable, too. That IS strange.

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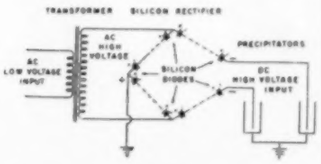
new products
. . . starts on page 25

706-Longer life for precipitators

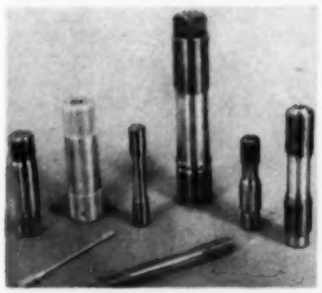
Oil-immersed silicon rectifier sets for electrostatic precipitators extend precipitator rectifier life to at least 10 years. Units operate with a rectifier efficiency of 96%, while tube sets operate



at efficiencies between 80 and 85%. Basic components are control unit, power transformer, and rectifier for changing high-voltage ac transformer output to dc current for precipitator. Silicon rectifier has tiny silicon cells connected in series on a frame immersed in oil with the transformer. Units have rated output of 70 kvp and 500 ma. RESEARCH-COTTRELL, INC.

707-Special studs for critical bolt jobs

High-strength studs for reliable large-diameter bolting can be used for critical fastening of steam turbines, nuclear reactors, and other high-temperature, high-pressure equipment. Custom-engineered studs range from ½- to 6-in. dia and from 6 to 72 inches long. High-strength,



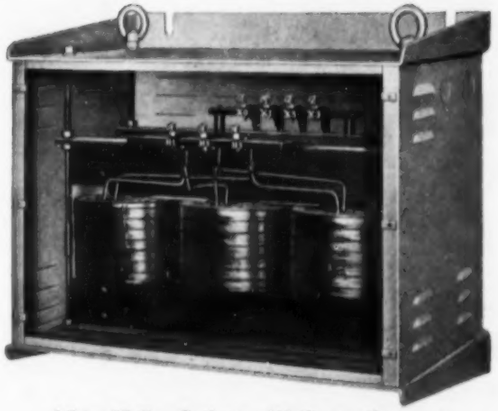
high-temperature, corrosion-resistant alloy steel studs can be supplied with tensile strengths of over 200,000 psi for moderate temperature applications and to 170,000 psi for temperatures to 900 F. Available in standard rolled threads to 4½-in. dia or Hi-R thread that has larger than normal root radius. STANDARD PRESSED STEEL CO.

(continues on page 32)

The first cost of dry-type transformers is not always the total final cost

Because *Some dry-type transformers cost more to install than others.*

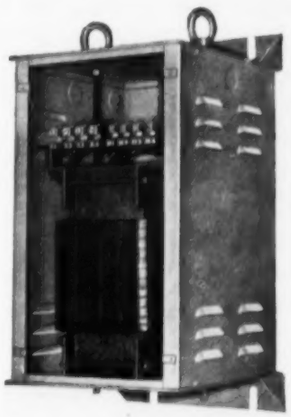
But SORGEL air-cooled dry-type transformers cost less to install because they are all self-contained in a single unit — either single phase or 3-phase — equipped with substantial wall brackets with slots for bolts, or with floor mounting base. No separate brackets to make or buy. Easily accessible, roomy connection compartment, with wide choice of knockouts. Equipped with solderless terminals and permanent connection diagram.



15 to 50 Kva 3-phase. Wall mounting. Connection compartment panel removed.

Because *Some must be installed in locations that require longer feeders and more expensive wiring.*

But SORGEL transformers are so quiet in operation that they can be installed in almost any convenient place inside of buildings, close to the load center. This results in shorter feeders, better voltage regulation, more efficient distribution, and lower wiring cost.



20 to 75 Kva single phase. Wall mounting. Connection compartment panel removed.

Because *Some require a larger rating for a certain load.*

But SORGEL transformers do not require a larger rating than the load, because they are guaranteed to carry their full rated load continuously at high efficiency. They are so liberally designed that they can carry an overload during an emergency at a safe operating temperature. Vacuum impregnated windings brazed to solderless terminals assure years of trouble-free service.

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Consult the classified section of your telephone directory or communicate with our factory.

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Roxbury, Mass.	Rockford, Ill.
High Point, N. C.	Richmond, Ind.
Raleigh, N. C.	Cedar Rapids, Iowa
Philadelphia, Pa.	Davenport, Iowa
Cincinnati, Ohio	Omaha, Neb.
Cleveland, Ohio	Beaumont, Texas
Louisville, Ky.	Los Angeles, Calif.

Complete Line

¼ Kva to 2500 Kva single phase.
1 Kva to 3000 Kva 3-phase, 2 phase, and phase changing.
All standard voltages, such as 120, 208, 240, 480, 600, 2400, 4160, 4800, 7200, 13,200, and up to 15,000 volts, and any intermediate or special lower voltage.

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40 years' experience in the development, manufacturing and application of transformers

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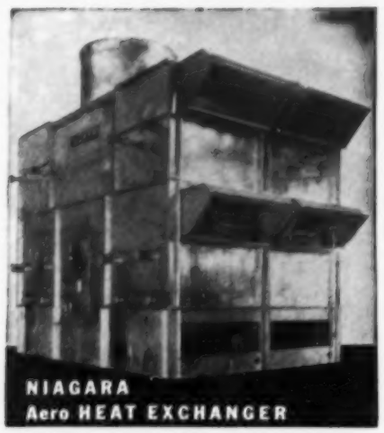

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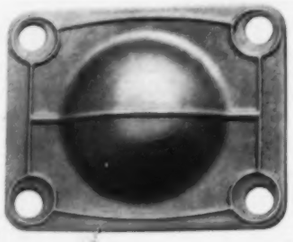
ip new products

. . . starts on page 25

708-Diaphragm valve has Teflon facing

Valve diaphragm has solid Teflon sheet permanently bonded to face and external edges of backing. Diaphragm protects against corrosion both from internal flow and from atmospheric conditions. Combines chemical resistance of solid Teflon diaphragm and hydraulic



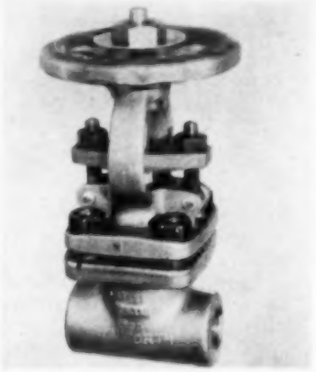
shock-absorbing flexibility of elastomeric diaphragm. Sealing-bead construction gives positive closure under pressure or vacuum at operating temperatures from −10 to 240 F and line pressures to 150 psi. Typical service applications include concentrated sulphuric, nitric, or hydrochloric acids, organic solvents, chlorinated hydrocarbons, ketones. (Not recommended for gaseous fluorides or chlorides or in slurry service.) HILLS-MCCANNA CO.

709-Plate magnet traps harmful tramp iron

Magman plate magnet of Hyflux Alnico V uses offset air gap principle to remove tramp iron from flowing material in chutes, spouts, ducts, or conveyors. With offset air gap design, magnetic force is concentrated directly over the first pole piece. Tramp iron enters the powerful magnetic zone abruptly, is held securely at the air gap. Design eliminates possible troublespot when air gap is centered between equal pole pieces – given sufficient momentum, tramp iron, accelerated by air gap, could be swept past the magnet. Available in three series depending on strength of pull required in widths from 6 to 48 inches. STEARNS MAGNETIC PRODUCTS.

710-Wedge gate valve for high temperatures

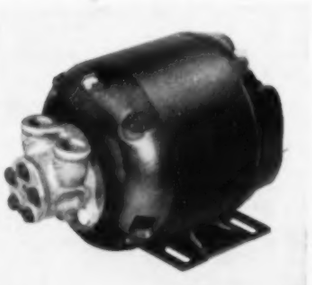
Steel wedge gate valves with screwed or socket welding ends are designed for water, steam, gas, or air at temperatures to 850 F and for oil or oil vapor to 1000 F. Valve body is of forged carbon steel. Stem, wedge, and seat rings are of



13% chromium stainless steel. Valve design permits repacking under pressure when fully open. Repacking is simplified by curved yoke arms and swing-type eyebolts that provide free access to stuffing box. Valves with union bonnets come in eight sizes from ¾ to 2 inches; bolted bonnet types come in six sizes from ½ to 2 inches. WALWORTH CO.

711-No coupling used in this pump-motor unit

Positive displacement pump and driving motor units can be used with a variety of fluids in such services as pumping hydraulic fluid, fuel oil, lubricants. Pump is mounted on motor,



eliminating need for coupling, adapter, or base. Design saves space, reduces weight, simplifies installation and maintenance. Flow capacity range is from 20 to 300 gph with pressures to 1500 psi. Motors are ¼ hp and up. TUTHILL PUMP CO.

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We're Putting The "GO" Into America's Nuclear Navy.

History was made in January 1955 when the submarine U.S.S. Nautilus, powered by the Westinghouse-engineered "S2W" atomic engine, began its sea trials. For the first time controlled nuclear fission had successfully provided the motive power for a vehicle or vessel, paving the way for the creation of the world's first nuclear powered fleet.

***Engineers!** If your background includes pump, valve, or arrangements experience you are invited to join Westinghouse in this momentous undertaking.*

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Dept. M-19
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P.O. Box 1047, Pittsburgh 30, Pa.
First in Atomic Power

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712-Package CO_2 system protects against fire

Carbon dioxide fire extinguishing systems, for industrial applications where flammable liquids are found, use from 10 to 300 pounds of carbon dioxide to protect rooms to 6000 cu ft. Package system includes one or more CO_2 cylinders, rate-of-

temperature-rise fire detectors with tubing, automatic control and discharge heads with manual actuating device, Multijet discharge nozzles, cylinder supporting frame. Optional equipment includes local and remote manually operated actuating controls, alarms operated by pressure of discharging CO_2, pressure-operated trips and switches for closing doors and windows or turning off electric equipment and machinery. Walter Kidde & Co., Inc.

713-Change motor speeds simultaneously

Variable-speed, multiple-drive system can be automatically controlled in response to a variety of input signals for changing speeds of several motors equally and simultaneously. Sys-

tem combines Varidyne power unit using one or more ac induction motors and Varitrol automatic pneumatic control system. The Varidyne-Varitrol control system is suitable for many applications. Signal system to the Varitrol may be one of many standard control instruments that are affected by such variables as temperature, pressure, humidity, weight, velocity, etc. Varidyne motors are available in many enclosures and speed ranges. Optional integral gearing or integral variable speed transmission available for speed trimming. U. S. Electrical Motors Inc.

714-Higher flow rates with filter cartridge

Filter cartridge type PL permits higher flow rates with lower pressure drops for filtering oil, water, other liquids. Filter paper is impregnated with a heat-stabilizing resin, then pleated and cured at the stabilizing temperature. Cartridge filters out particle sizes down to 5 microns. Continuous recirculation gives even finer filtration. The Hilliard Corp.

MORE INFORMATION

For more detailed free information on these products just circle the key numbers on a READ-N-CIRCLE card on page 29 or 30.

715-Thermostatic steam trap won't freeze up

Quik-Flex thermostatic steam trap is guaranteed freezeproof in outdoor industrial steam processing applications. Trap has

downward flow of steam and condensate, permitting continuous automatic drainage. Removable cap permits easy maintenance and access to trap interior without disconnecting pipe fittings. Tapered, guided valve provides leakproof seating. For capacities to 31,000 lb/hr. Sizes range from ½ to 1¼ inches. The V. D. Anderson Co. ♦♦

RAMBLINGS ON INSTRUMENTATION

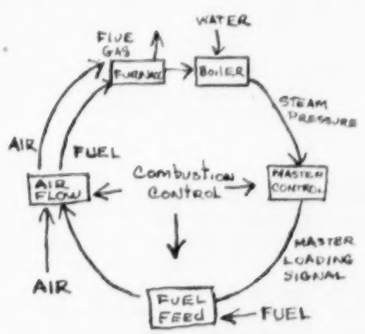
The Low-Down on Boiler Plant Control Systems—Chapter 3

Three months ago we set out to explain the fundamentals of a boiler plant instrumentation system. To review, we pointed out that the gadgets on a typical instruments panel (see sketch) are used to provide information and to control variables in the combustion process.

For example the draft gauges (labeled A) provide information on variations of gas or air pressure or draft. The flow meters (labeled B) measure fuel and water flow into the boiler and the flow of steam from the boiler. Now to the Combustion Controls.

Once upon a time there was a company treasurer whose eyeballs did *not* flash dollar signs when the subject of saving fuel was mentioned. But there has never been one since. That's why Automatic Combustion Control was born.

Basically Combustion Controls (C on panel diagram) are a series of black boxes whose function is to automatically control fuel and air for the most efficient combustion in the boiler furnace for any rate of steam output from the boiler. Like any self-regulating system, they operate on the "closed loop" principle (see diagram). The Master Control is the GHQ



of the system, getting steam pressure reports constantly from the boiler and flashing instructions on to the Fuel Feed and Air Flow Controllers.

As steam pressure rises and falls, the Master Control automatically flashes loading signals to adjust the flow of fuel accordingly. The fuel is metered on its way to the boiler and the rate of flow is reported to the Air Flow Controller, which automatically adjusts the air flow to provide the most efficient fuel/air ratio. And, to make things even more complex, the Master is consistently comparing "what it did" with "what is needed." Result: steam delivered at the lowest possible fuel cost.

Combustion controls can be operated pneumatically, hydraulically or electrically. Our preference is distinctly in favor of electricity. It's clean . . . available . . . does not freeze, drip, harden, leak or gurgle.

The Hays Electric Combustion Control (to pick a name at random) also has a host of other advantages, which we will elaborate on next month. (If you'd like a preview, send for our bulletin 55-605-83, a veritable treasure trove of information on Boiler Plant Instrumentating.)

Thoughts While Shaving

Has it occurred to you that, even back in the '30's, a steam station with a crew of thirty people could handle a series of operations many times more complex than some of today's highly touted automated process plants? That power plant engineers have been deeply involved in "systems engineering" (the newly discovered automation tool) for quite awhile? That, when it comes to fascinating, efficient control rooms, the power industry doesn't have to take a back seat to anyone? Maybe we've been caught with our Public Relations down!

Phil Sprague Jr.

President

THE HAYS CORPORATION • MICHIGAN CITY, INDIANA

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IP handy guide to engineering literature

AIR CLEANING EQUIPMENT

136-Make your air come clean

Let Norblo specify collecting systems to solve your dust or fume problems. Read page 43 – The Northern Blower Co.

117-Dust collector tubes have 9 lives

Dust collector tubes give extra long life under accelerated tests. Read page 39 – The Aerotec Corp.

400-Packaged dust collector performance data

Data on type W Roto-Clone dynamic precipitator in Bulletin 274B include performance tables, wiring diagrams, pipe resistance chart, erection diagrams, normal water supply tables, dimensions for sludge settling tanks, and humidifying efficiency graphs. Water spray feature of type W precipitator maintains water film on collecting surfaces to lower water requirements and to trap minute dust particles. Sixteen pages. American Air Filter Co., Inc.

600-Activated carbon removes irritating vapors

Irritating vapors from volatile solvents threatened shutdown of Dandecal Div. of Consolite Corp. Ingenious air control system keeps temperature and humidity constant, gives complete air purification. Industry Power reprint.

601-Contaminants in the air

Air pollution report describes contaminants and troubles they cause, legal aspects of air pollution, types of collecting equipment. Industry Power Special Report. (Single copies free – quantity prices on request.)

AIR CONDITIONING, HEATING, VENTILATING

102-Duct fans cut ventilating costs

Take advantage of lower equipment, installation, and maintenance costs with Hartzell line. Read page 35 – Hartzell Propeller Fan Co.

138-Gas unit heaters give fast, safe heat

For extra heat in hard-to-heat areas, for process heat, for eliminating problems from excessive dampness, try gas unit heaters. Read page 36 – Reznor Manufacturing Co.

126-Keep air fresh in confined places

Design A ventilator freshens air in confined places to improve worker safety, health, comfort, efficiency. Read page 49 – Coppus Engineering Corp.

401-Performance charts in propeller fans

Revised specifications, performance data, and dimension drawings on entire line of propeller fans are contained in Bulletin A-109B. Includes data on reversible, low-noise, and utility fans, with description of heating and cooling units. Forty pages. Hartzell Propeller Fan Co.

Air conditioning and refrigeration basics booklet

Five-part series reviews basic refrigeration principles. Covers air refrigerators and heat pumps, mixtures of gases, gases and vapors, air conditioning processes, properties of refrigerants. Provides a thorough reference on air conditioning and refrigeration processes. Forty-eight pages. Industry Power booklet. (50¢ per copy – send check or money order – quantity rate on request.)

BOILERS AND BOILER ACCESSORIES

130-Set it — forget it!

Boiler feed regulator gives constant, dependable regulation always. Easy to install, maintain. Read page 38 – Henszey Co.

107-Package generators keep oil pumps pumping

Case history of oil company's use of FW package generators to furnish steam to pump over 7 million gallons of oil in less than 3 months. Read page 24 – Foster Wheeler Corp.

114-Low-cost steam becomes a reality

Heavy-duty construction, low maintenance, extra power make Leffel boilers outstanding. Read page 37 – The James Leffel & Co.

146-For dependable, economical service

Type-A steam generators combine custom engineering and shop assembly for economical packaged power. Entire unit shipped complete. Read pages 8, 9 – The Wickes Boiler Co.

402-Design data on water-tube package boilers

Water-tube package boilers are described in Booklet 5000. Design and construction features are shown in cutaway drawings. Includes list of standard equipment, optional equipment, and performance curves. Seven pages. International Boiler Works Co.

602-Steam packaged for expansion

Additional package steam generators with automatic controls give Rapids-Standard Co.

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sufficient steam for present and estimated future space heating needs. Intelligent approach to future expansion solves heating problems before they start. INDUSTRY POWER reprint.

603-Case history of outdoor package boiler

Shell Development Laboratories decided to install package boiler outdoors in spite of hazardous location. Here is case history of boiler's performance. INDUSTRY POWER reprint.

Thermodynamics basics booklet

Seven-part series on thermodynamics basics from concepts and definitions through computing steam powerplant heat balances. Text is amplified by charts and diagrams, sample problems. Fifty pages. INDUSTRY POWER booklet. (50¢ per copy — send check or money order — quantity rates on request.)

ELECTRIC DISTRIBUTION

105-Air cooled dry-type transformers cost less

Single- or 3-phase transformers are self-contained in single unit ready to install. Read page 31 — SORGEL ELECTRIC CO.

135-Match power factor correction to the motor

Unipak capacitors are self-contained. Need no additional switches or fuses. Sizes from 1/2 to 15 kvar. Read page 47 — SPRAGUE ELECTRIC CO.

132-Protect with new insulating materials

Latest developments in porcelain and ceramic insulating materials give extra value and protection. Read page 4 — I-T-E CIRCUIT BREAKER CO., SWITCHGEAR DIV.

112-New molds simplify electrical connections

New E-Z-Change handle clamps for standard Cadweld connections fit directly into graphite mold. Read page 21 — ERICO PRODUCTS, INC.

119-Distribution transformer is completely sealed

Totally sealed construction in dry-type distribution transformer keeps out dust. Read page 36 — ACME ELECTRIC CORP.

(continues on page 36)

How Hartzell Duct Fans Help Cut Ventilating Costs

Lower Equipment Cost

Hartzell fans are competitively priced . . . yet they're designed and built for maximum reliability and long life. When you compare prices, estimate the service life of each make and rank them on the basis of cost per year of useful life. On that basis, Hartzell fans will always be by far your best buy.

Lower Installation Costs

Hartzell duct fans are much easier to install than many other types of ventilating equipment which might be used to do the same air-moving job. Each fan is a completely pre-fabricated duct section. To install a Hartzell duct fan you need only cut a section of duct work the same length as the fan, bolt angle iron flanges to the duct ends and bolt the fan to the flanges. After that, just install bracing and make electrical connections and you're done. Easy installation means fast installation . . . and real savings on costly labor charges.

Lower Maintenance Costs

Hartzell duct fans require practically no maintenance. Their rugged construction and the high standards of quality in workmanship and materials to which they must conform practically eliminate failures under normal operating conditions. Routine maintenance requires nothing more than periodic lubrication and occasional replacement of belts. Motors on direct-drive models and bearings on belt-drive models are Alemite-lubricated from outside the duct. Belt changes or adjustments on belt-drive models are also conveniently made from outside the duct. Hartzell design and construction holds maintenance to a minimum . . . and that's a vital consideration under today's wage scales.

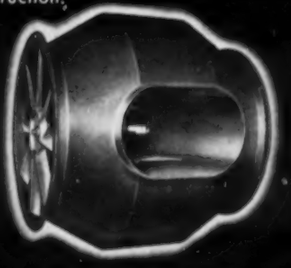
For complete details on Hartzell duct fans and how they can help you cut your air-moving costs, just call your nearby Hartzell field engineer. If you don't know him, just drop us a line for his name and address. And be sure to ask for Bulletin A-109.

Why You Can Count on Hartzell Air-Moving Equipment for Long Life, Rugged Reliability and Minimum Maintenance

Hartzell fans and blowers are engineered and built for the exacting requirements of tough industrial service. There's no compromise with quality for the sake of shaving a few dollars on price. Hartzell fans are designed for the industrial buyer who is willing to pay for long life, dependable service and low maintenance.

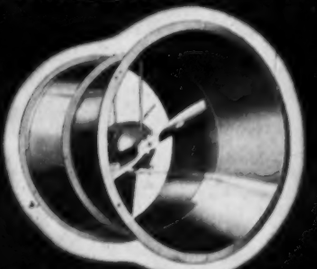
BELT DRIVE DUCT FAN

These fans are the best choice for most installations where air (including that containing fumes, corrosive elements or dust) must be moved through a duct. Fourteen sizes, 12" to 60" fan diameters; single-propeller, two-propeller or multi-blade models in belt-drive or direct-drive construction.



BI-PASS DUCT FAN

This special model, with motor mounted in a tunnel completely out of the air stream, is designed for moving corrosive fumes and air at temperatures as high as 550° F. Six sizes, 19" to 41"



REVERSIBLE DUCT FAN

This fan moves air in either direction with equal efficiency and can be supplied with controls for manual or automatic reversal. It is useful in many ventilating applications as well as in cooling and drying processes. Four sizes: 18" to 44".

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IP handy guide

. . . starts on page 34

403-Handy chart corrects ratio-phase angles

Instrument transformer theory and operation are discussed in Bulletin 6188528. Fully indexed bulletin covers transformer function, types, polarity markings, insulation, impluse protection, accuracy. Includes useful ratio-phase angle correction chart. Twenty-four pages. ALLIS-CHALMERS MANUFACTURING CO.

404-How to choose circuit breakers

Essential information on selection and application of molded case and large air circuit breakers is presented in this Speedfax catalog. Application sections use charts and tables to explain selection of circuit breakers for motor circuits, bus duct, conductors, and transformer secondary applications. Includes latest prices, dimensions, other data. Sixty pages. I-T-E CIRCUIT BREAKER CO.

604-In-plant electric distribution systems

Report summarizes trends in electric power distribution in industrial plants. INDUSTRY POWER report. (Single copies free — quantity prices on request.)

605-Lightweight aluminum bus cuts installation costs

Ethyl Corp. engineers designed and built their own aluminum bus to transfer 30,000 dc amps from one rectifier station to another. Lightweight installation with aluminum cuts cost of supporting structures. INDUSTRY POWER reprint.

606-Save with unit switchgear off the shelf

Adroit engineering at Bridgeport Brass Co. permits tailormade expansion of electric distribution system with standard, catalog-listed switchgear. INDUSTRY POWER reprint.

ELECTRIC UTILIZATION

140-Clean, uniform heat to meet your needs

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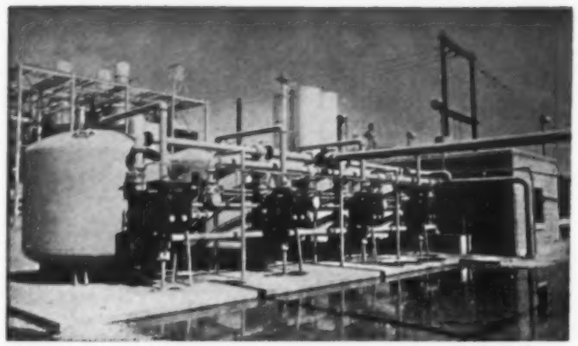

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tanks, pipes, etc. for dependable heat. Read page 40 — EDWIN L. WIEGAND CO.

405-Guide to care of electric motors

Handbook 51X6229A reviews basic maintenance requirements for industrial electric motors. Clever cartoons and non-technical presentation of essential maintenance routines should make it a favorite with both management and maintenance personnel. Dust, strav oil, moisture, friction, misalignment, vibration, uneven wear, and over- and underloading are covered. Chart aids quick diagnosis of motor ills. Sixteen pages. ALLIS-CHALMERS MFG. CO.

Electrical basics booklet

Six-part series reviews fundamental concepts of conductivity, resistance, magnetism, direct current and alternating current machinery, single-phase alternating current circuits, polyphase alternating current circuits. Fifty-two pages. INDUSTRY POWER booklet. (30¢ per copy — send check or monev order — quantity rates on request.)

FIRE PROTECTION

607-Tailor-made fire protection

Safe fire protection should be an integral part of facilities it protects. One utilitv company accomplished this as part of expansion program. INDUSTRY POWER reprint.

FUELS AND FIRING EQUIPMENT

124-Chessie's railway for fast coal delivery

Superior coals from Chessie's area are sized, processed, delivered to suit vour needs. Read page 17 — CHESAPEAKE AND OHIO RAILWAY.

608-LP means loss protection

One company avoids shutdown terrors from fuel shortage with LP gas standby plant. Operation of propane-air gas plant is described. INDUSTRY POWER reprint.

609-Get best coal buy for your company's money

Read how one company evaluates different coals for maximum fuel economy. Includes 12 charts to aid in coal comparison. INDUSTRY POWER reprint.

610-Fire either coal or oil

Equipping boilers to fire either coal or oil permits taking advantage of fluctuating fuel prices, gives security of standby fuel in emergencies. Paper Manufacturers Co. can supply all the steam they need with coal or oil. INDUSTRY POWER reprint.

HEAT EXCHANGERS

134-Trouble-free cooling with atmospheric air

Cool jacket water for engines, process equipment, electric apparatus with atmospheric air. Save water, pumping, piping, and power. Read page 32— NIAGARA BLOWER CO.

406-Condenser, jet air ejector specs

Engineering data in steam condenser bulletin include method of determining heat transfer rates, pressure drop, tables converting absolute pressure inches Hg to saturation temperature in F. Conseco inter-after condensers normally operate with low condensate flow with twin-element, two-stage steam jet air ejectors. Bulletin gives tips on maintenance. Twenty-four pages. CONDENSER SERVICE & ENGINEERING CO., INC.

INSTRUMENTS AND CONTROLS

103-Dial thermometers always readable

Direct-drive mercury actuated dial thermometers can be rotated to any position. Accuracy is constant. Read page 46 — PALMER THERMOMETERS, INC.

100-Displacement meters for process control

With Electricontact meters you get exactly what you set — no more, no less. Read page 11 — BUFFALO METER CO.

109-Maintenance is easy on water level controls

Magnetrol stays in top shape with simplified maintenance program. Read page 41 — MAGNETROL, INC.

(continues on page 47)

Have you read . . .

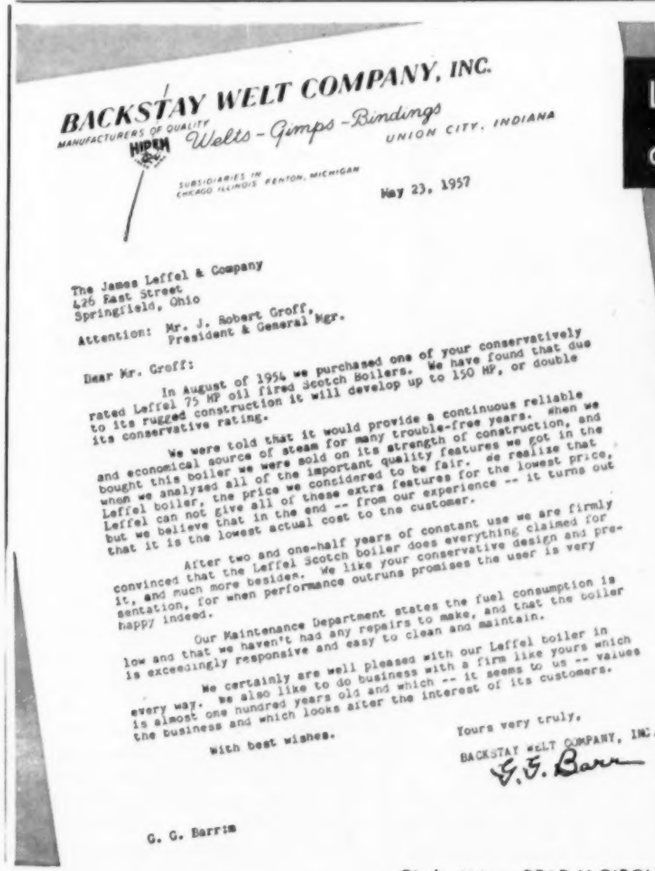
Unions for engineers?

Joseph Amann, president of Engineers and Scientists of America, discusses the points in the program that the unions are presently aiming at. On the other side of the fence, Harry H. Rains, labor counsellor, suggests what management could do on its own and what the engineer could do to help himself.

Perhaps you have other ideas for helping engineers throughout industry to attain true professional status. If so, the editors of INDUSTRY POWER will be glad to hear them and publish them.

In the meantime, read what these two spokesmen have to say on this subject that is so vital to management and engineers alike . . .

read page 12



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The James Leffel & Company
426 East Street
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Attention: Mr. J. Robert Groff,
President & General Mgr.

Dear Mr. Groff:

In August of 1954 we purchased one of your conservatively rated Leffel 75 HP oil fired Scotch Boilers. We have found that due to its rugged construction it will develop up to 150 HP, or double its conservative rating.

We were told that it would provide a continuous reliable and economical source of steam for many trouble-free years. When we bought this boiler we were sold on its strength of construction, and when we analysed all of the important quality features we got in the Leffel boiler, the price we considered to be fair. We realize that Leffel can not give all of these extra features for the lowest price, but we believe that in the end -- from our experience -- it turns out that it is the lowest actual cost to the customer.

After two and one-half years of constant use we are firmly convinced that the Leffel Scotch boiler does everything claimed for it, and much more besides. We like your conservative design and presentation, for when performance outruns promises the user is very happy indeed.

Our Maintenance Department states the fuel consumption is low and that we haven't had any repairs to make, and that the boiler is exceedingly responsive and easy to clean and maintain.

We certainly are well pleased with our Leffel boiler in every way. We also like to do business with a firm like yours which is almost one hundred years old and which -- it seems to us -- values the business and which looks after the interest of its customers.

With best wishes.

Yours very truly,
BACKSTAY WELT COMPANY, INC.
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G. G. Barrim

Low Cost Steam is a Reality at the Backstay Welt Company

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Many Leffel boilers throughout the country are still providing low cost steam even after 50 years of efficient service because they're built as only Leffel can build them.

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Bulletin 236, free on request, gives complete details on Leffel boilers for oil, gas or coal firing. If you need help in planning your boiler installation, Leffel engineers—backed by 95 years of experience in efficient steam generation—are available for consultation without obligation.

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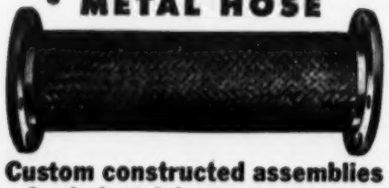

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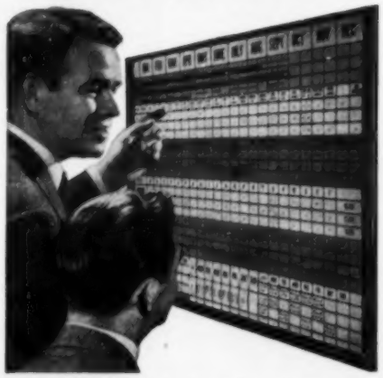

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Circle 143 on READ-N-CIRCLE card

Unions? — Pro

. . . starts on page 12

• An engineers' union can employ both legal and economic tools with which to apply pressure to the company in attempting to convince management that its demands are proper and fair
• An engineers' union is a completely democratic institution, bringing industrial democracy into the engineering department where it is so badly needed.

The first engineers' unions were established in the mid-1940's. Today, about 65,000 engineers and scientists in this country are represented by engineers' unions. Virtually all the engineers' unions established prior to 1952 were independent local plant operations. In 1952, these independent engineering unions established the Engineers and Scientists of America (ESA) as their national organization and most are now member units of ESA.

what engineering unions seek to accomplish

ESA and its member units are actively engaged in an endeavor to raise the economic and professional status of the engineering profession through the process of collective bargaining. To carry out this program, ESA is seeking to:
• Raise engineers' and scientists' salaries to a level where they will be commensurate with the engineers' contributions to society and to the enterprise employing them
• Restore the value of experience and proficiency so that there will be a future in an engineering career from a remunerative standpoint, and that there will be incentive for an engineer or scientist to develop his technical competence to whatever extent his natural abilities will permit
• Make merit raise programs realistic. These programs have been widely abused, particularly during the period of inflation that has existed since the mid-1940's. Engineers are given merit increases, but just enough to keep their salaries even with the increasing cost of living. Such increases are not, in the real sense, merit increases. Occasionally, increases that are less than this amount are given — in which case the engineer involved has effectively suffered a salary cut
• Improve the environment wherein engineers and scientists must do creative work
• Bring about substantial improvements in the utilization of engineers and scientists, to afford them a maximum opportunity to develop their competence and realize the advantages thereof
• Encourage employers to set up their engineering organizations so that an engineer or scientist who would prefer to remain in technical work does not find it necessary to transfer his activities to administration in order to realize a higher income
• Eliminate "gentlemen's agreements" among employers with respect to hiring practices and transfer of personnel folders from one employer to another when an engineer seeks to change his employment
• Provide means whereby practicing engineers and scientists may acquire additional education and attend technical society meetings without suffering salary loss and without paying the expenses involved
• Encourage management to develop methods and techniques by which the technical ability and ultimate capacity of an engineer can be more reliably measured than at present
• Bring industrial democracy with all its desirable features into engineering departments.

Engineering unions are also engaged in activities beyond the scope of collective bargaining, such as: advising engineering students on what to expect when they enter the industrial world; advising them about their economic opportunities as employed engineers; advising them that less than 10% of them will ever become supervisors or managers.

Engineering unions and the managements with whom they deal can anticipate many problems and devise solutions and adjustments through the medium of collective bargaining. Engineering unions exist for the purpose of giving service to their members and providing industrial democracy in the engineering departments of corporate enterprises. In this day of corporate bigness, of a group pressure society, industrial democracy is a completely necessary prerequisite to political democracy if our democratic system, which emphasizes the importance of individuals, is to survive. ♦♦

Unions? — Con

. . . starts on page 13

prompt, fair and dignified airing of any complaint as well as provide opportunities for the procurement of redress through appelate channels.

The importance of a sincere effort on management's part to fully develop its engineering personnel cannot be over emphasized. The practice of job rotation needs more than lip service or a casual, inconsistent and opportunistic application. All too frequently, needs for the future are sacrificed for the emergency of the moment or what may happen to be the easiest way out, production-wise, without thought for the future.

management errors often rile employees

Some of management's errors, of course, flow down from the top in a singularly blind failure to recognize the obvious. For example, even with mass employment of professional salaried workers it does not make sense to have such personnel subjected to a time-clock "punch-in-punch-out" requirement. There are some practices which carry with them a connotation of special status in employment. Such practices assume importance where management is avowedly aiming at development of professional status for the engineer. Just as the army has its special gold braid to designate Field Officers, so does industry, company by company, develop its own special attributes of high level status. It becomes very important for management to know its own symbols and use them appropriately in the development of the professional engineer.

Summing up, we can say that:

- All factors indicate a continuance of unionization on an accelerated plane for engineers who are employed en masse, unless management and the professional societies undertake the re-appraisal and re-orientation of their objectives and practices in relation to the professional engineer employed in industry
- Important aid towards the development of a significant role by the professional societies in their protection and development of professional status for engineers in industry requires a more enlightened and active membership participation in society affairs on the broadest possible base. Industry and engineers should count on effective aid from the professional societies and protective legislation relating to professional status. They should rely on their societies as the most effective means of procuring the facts through professional surveys conducted, evaluated, and reported on in truly professional manner so that all facts relating to engineers may be procured promptly and publicized
- Industry should look to the professional societies for effective recommendations on the problems of education and supply of professional engineers and scientists
- Management's responsibility requires a deliberate study program for the adoption of good human relations practices that are specifically geared to the particular needs of its own organization and engineering personnel. Such principles and practices could be inculcated by a formal program of study and follow-up procedures for all levels of supervision. Management must also adopt suitable published policies to define ground rules for the treatment of its professional salaried employees in such a manner as to insure retention and development of their professional status. Management must devise a means of developing those techniques, including adequate communications, so as to develop cooperative management liaison and multiple management participation between the engineering personnel and other key executive and staff personnel within the company
- The desired attainment and retention of professional status by the salaried professional engineer and scientist in industry demands a sincere effort by both the engineer and management responsible for direction of the employer entity. Continued failure even in part by management, the professional salaried engineer, and the professional societies will carry with it implications of serious concern to the security of our own consumer economy, which requires continuous technical and scientific improvement of work methods and industrial products. ♦ ♦

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Fight Corrosion

. . . starts on page 16

the top. This creates flow resistance as the water rises. Spill holes are located at regular intervals all the way up.

Surge tank is 135-ft high, 55-ft dia, and constructed of riveted steel plates. A 14-ft dia outlet at the bottom of the surge tank connects through a "Y" coupling with two sheet-steel penstocks. These are each 414-ft long and taper from 10-ft dia at the "Y" to 8 ft 9 in.-dia at the exit end, where butterfly valves control water flow.

The flow line was originally constructed entirely of wood. In 1956 some 8000 feet were replaced with steel sections constructed by Bethlehem Steel Company.

Water from Lake Wallenpaupack gravity feeds through the flow line to the differential tube, enters at the bottom, rises inside and spills over into the surge tank through spill holes. Here, the water is diverted into the penstocks where its flow is controlled to drive the turbogenerators.

corrosion was a problem from the very start

Unavoidable exposure of all metal parts to water immediately posed the problem of corrosion control. Water in Lake Wallenpaupack is natural surface drainage water that is highly saturated with carbon dioxide and oxygen; it is also a soft water, low in total dissolved mineral solids. As a result, it is relatively corrosive.

When the surge tank, differential tube, and penstocks were erected, they were coated with conventional paints for corrosion prevention. When opened in summer 1956 for maintenance, it was found that the surfaces were quite generally pitted to varying depths.

preventive maintenance was essential

Converting the flow line from wood to steel further emphasized the need for an effective preventive maintenance program. In anticipation of this conversion, Pensylvania Power & Light undertook a series of investigations in 1955 to determine the most effective pre-

Steel surfaces of both differential tube and surge tank are protected against corrosion with two coats of zinc-rich paint, plus a barrier coat of phenolic resin.

Steel butterfly valves at lower end of penstocks are constantly subjected to mechanical and corrosive attack by drainage water, high in CO_2 content.

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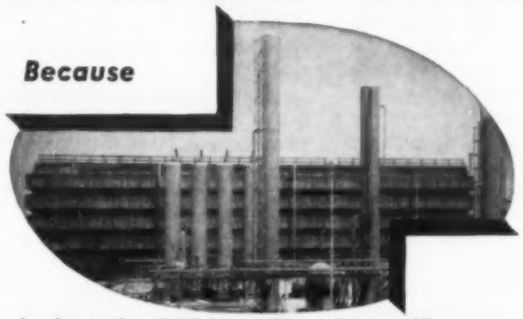

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ventive maintenance coating material practicable.

Several organic and other coatings were tested for physical and chemical properties. Careful attention was given to adherence, corrosion inhibition, permeability, ease of application, and resistance to work damage. Optimum thickness with minimum number of coats, and tendency to crack or flake were some of the characteristics observed.

Results suggested that zinc-rich paint and zinc dust – zinc oxide paint, with suitable vehicles, would offer the longest service life and best adherence under these conditions.

Zinc-rich paint is formulated with approximately 95% zinc dust in suitable binders such as plasticized polystyrene, chlorinated rubber, and some inorganic materials. These have sufficient strength to carry the high pigment concentration involved and still provide excellent adherence and flexibility.

80% zinc dust–20% zinc oxide paint is excellent for atmospheric and underwater protection. It provides effective rust-inhibitive properties, abrasion resistance, adherence, and is known commercially as Metallic Zinc Paint (M.Z.P.).

Corrosion is known to be an electrochemical process in which the metal dissipates itself as ions. Zinc dust in zinc-base paints inhibits corrosion by "sacrifical" action in which the zinc is dissipated while the underlying iron or steel remains sound.

Zinc-rich paint with a chlorinated rubber vehicle was chosen to protect the surge tank, penstocks, and butterfly valves. Zinc dust – zinc oxide paint, in a phenolic resin, was selected to meet the corrosive conditions in the flow line.

how the paint was applied

After proper cleaning of the steel surface, two coats of zinc-rich paint were applied to the inside and outside of the differential tube, the inside of the surge tank, the inside of the penstocks, and both sides of the butterfly valves. A final barrier coat of phenolic resin was added for extra long service life.

During application, the surface toughness of zinc-rich paint was demonstrated unexpectedly.

(continues on page 42)

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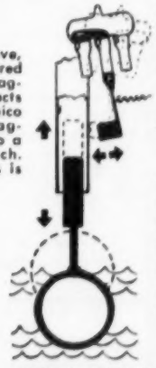

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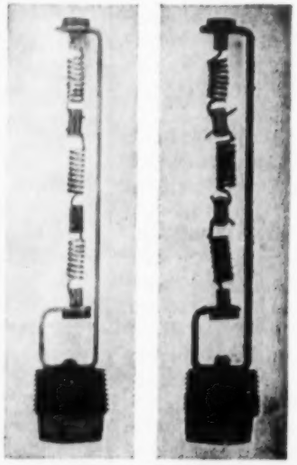
To demonstrate what corrosion can do in steam and condensate return lines, we show here "before" and "after" unretouched photographs of NDHA Corrosion Testers. This is a test* developed by the American Society for Testing Materials in cooperation with the National District Heating Association. Bird-Archer supplies and analyzes these testers. Photo at left shows a Tester before installation. Photo at right shows a Tester after it had been installed for 60 days in the return line. (*Standard Method of Corrosivity Test of Industrial Water, NDHA Method, ASTM Designation 935-49.)



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Because of inadequate sand blasting in the initial surface preparation, the contractor had to remove the coating from a small area. This was done only with extreme difficulty, even though sand blasting was used. This is an especially good demonstration, because the newly painted surfaces had not yet been exposed to water, and zinc-rich coatings inherently become harder and less subject to abrasion after a week or two of wetting.

A second advantage was realized when it was discovered that the second coat of zinc-rich paint could be applied effectively within two hours after the first coat, if necessary.

Workman checks coating thickness to assure compliance with specification requirements.

Coating the steel flow line was just as easy: after appropriate surface cleaning, the inside of the flow line was painted with two coats of 80% zinc dust—20% zinc oxide phenolic resin paint and a final phenolic enamel barrier coat. The outside was then painted with a well established inhibitive primer. After this, intermediate and finish coats of zinc dust paint were to be applied, but this phase was interrupted by cold weather and will be completed late this summer.

In spite of tough weather, wear, and water conditions that prevail at the Wallenpaupack installation, the coatings are expected to furnish superior protection for a longer time than could be expected from materials heretofore available. Eventually, of course, exposure to mechanical and electrochemical forces will reduce their effectiveness to a level that must be checked and reinforced.

At such a time, the maintenance procedure indicated is simple: the loose paint and rust will be removed with a wire brush, and more zinc-rich paint applied. Experience indicates that the new paint will adhere satisfactorily to both the steel and remaining areas of zinc dust paint and give additional years of effective protection. ♦♦

U.S. Gypsum Company *fireproofs and insulates tanks*

A NEW TECHNIQUE for fireproofing and insulating oil storage tanks was used recently at United States Gypsum Company's Philadelphia plant.

Plans for expansion called for enlarging a building located close to three 50,000-gal fuel tanks. Municipal fire regulations threatened to block expansion unless suitable fireproofing were placed on the tanks.

A six-inch thick coating of Perlite (a lightweight expanded volcanic mineral that is rapidly replacing sand in gypsum plaster and insulating concrete) concrete was placed around each of the 18-ft diameter by 27-ft high tanks. Concrete was machine-sprayed onto a paper-backed wire lath which had been attached to a Trussteel stud framework erected around the tanks. Framework was connected only at the top of each tank and to runners circling the base. Thus the concrete construction was built structurally independent from the metal tank exterior. A dead-air space of 1-3/4-in. was provided.

Perlite concrete coating protects metal tanks from rust and weather, and is rot and vermin proof. Coating also presents a smooth monolithic surface that is easy to maintain. ♦♦

Fluid Mechanics

. . . starts on page 22

through the wall and connected through tubing to our measuring device. If the hole is not perpendicular to the surface, or if there is a burr near its end, it will under- or over-register the pressure. This is because the burr or inclination causes velocity at the piezometer mouth to be higher or lower than that in the fluid stream.

If we drill our hole perpendicular to the surface at which we wish to measure the pressure, and if we carefully remove any burrs from the drilling (usually by a slight rounding of the corners), then it will register the correct pressure. But suppose we wish to know the pressure away from the wall. What then? If our flow is occurring in straight and parallel lines, as in a pipe or uniform stream, then the pressure distribution across the flow is hydrostatic, as given by Eq. 2. In such a situation, pressure measurement at the wall suffices.

In some instances, such as flow around a bend, we have curvilinear flow – the streamlines are curved. Pressure variation is not hydrostatic; nor does Eq. 4 simply apply, as will be noted in our discussion of vortex motions. Some idea of pressure variation in such a case is obtained by considering centrifugal action. From mechanics we know that a centripetal force is required to keep a body moving in a curved path. Thus, in curvilinear fluid motion, we have a radial pressure gradient with greater pressure on the outside of the curve.

Pressure measurement away from a conduit wall requires introducing a device containing a piezometer into the flow. This must not significantly change the velocity – a difficult proposition even in parallel flow. To avoid such a disturbance in curvilinear flow, the device must conform to the flow curvature at the point of measurement. As a result, we are usually satisfied to measure the pressure with wall piezometers.

how fluid flow velocities are obtained

To properly consider the dynamics of fluid motions (to determine the force or pressure), we utilize relationships requiring knowledge of velocities. This kinematic factor is usually determined with the aid of a very simple relation called the *continuity equation*. This is just a mathematical statement of the simple fact that when fluid flows steadily through a length of rigid conduit, the amount of fluid entering must equal that leaving. For the incompressible condition that interests us here, this is expressed by the equation

$$V_1A_1 = V_2A_2 = Q \qquad (5)$$

where A = cross sectional area of conduit,

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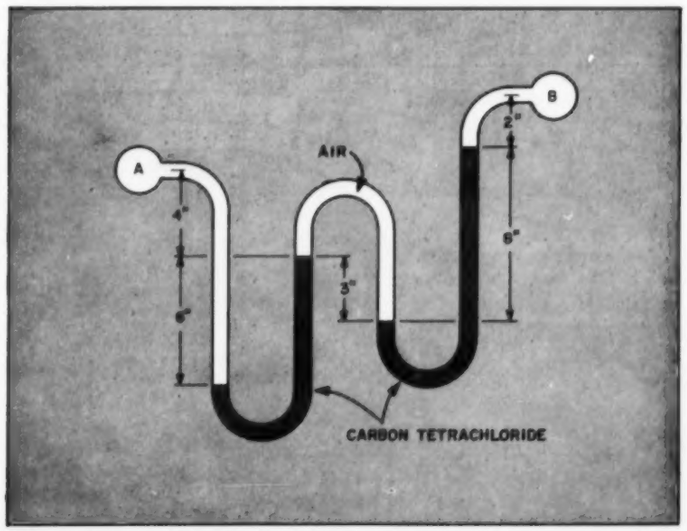

Fig. 4—Manometer indicates pressure difference between two pipes.

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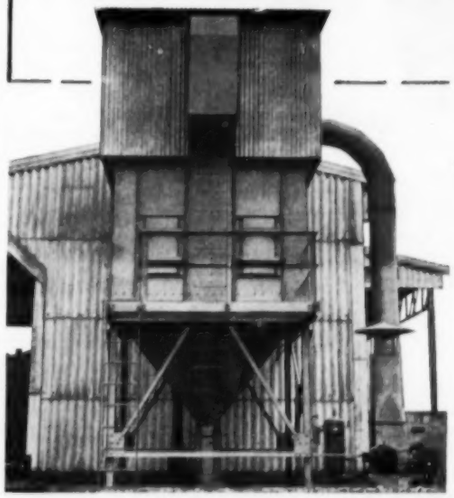

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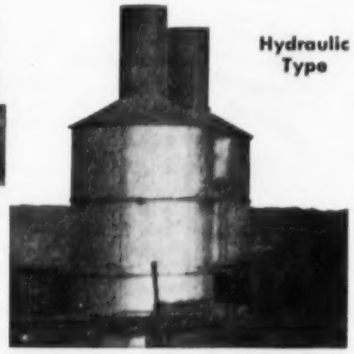

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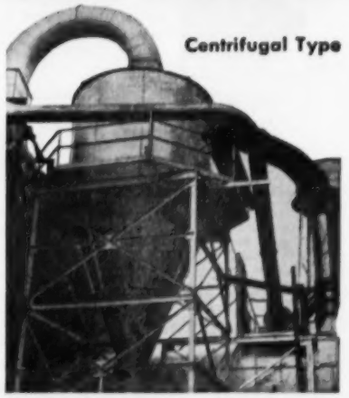

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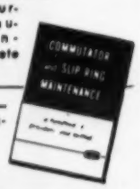

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and Q = volumetric of flow.

This approach to obtaining velocities is quite satisfactory as long as we are satisfied with the average velocity across the conduit. Fortunately, we often are.

Problems sometime arise — such as the bend previously discussed or in the flow around bodies — in which we need to know more details of the velocity variation. For this, we must resort to methods based on the mathematical theory of ideal fluid motion. In general, these are beyond an elementary approach. The pattern of streamlines representing a given flow situation is often obtainable mathematically by potential flow methods, graphically by constructing what is called the flow net, or by the electrical analogy. These last two methods are quite easy to apply.

Once we have obtained a flow net (a graphic picture of the streamline pattern), the determination of detailed velocity, and hence pressure distribution follows quickly. The flow net, such as shown in Fig. 5, consists of two sets of orthogonal lines. The streamlines represent the direction of the velocity at any point; the equipotential lines are perpendicular to them. If the streamlines are started with a constant spacing in a region of uniform velocity, then flow between adjacent pairs of lines is constant. The equipotential lines are constructed perpendicular to the streamlines at every point of intersection, and are spaced to form curvilinear squares. Thus, in those regions where the streamlines are parallel straight lines, the spacing Δn_0 between the equipotential lines equals Δs_0. This equality of Δn and Δs applies in the limit in other areas also. In a two-dimensional flow, the continuity equation becomes

$$V_0 \times \Delta s_0 = V \times \Delta s = V \times \Delta n \quad (6)$$

Where Δs represents spacing between the streamlines and subscript o refers to conditions at a known or reference location

Eq. 6 permits us to find the velocity along streamlines, rather than between pairs of them. Since walls of conduits or bodies are streamlines, and since we usually wish to know velocity variation along the walls, Eq. 6 is most useful.

Applying Eq. (6) to the flow net shown in Fig. 5, we obtain the result shown in Fig. 7 for variation in velocity along the wall of the contraction. Streamline curvature causes velocity distribution along the wall to vary considerably from the average velocity as predicted by Eq. 5. Divergencies from the results obtained from the simple continuity equation are even more apparent in terms of pressure variation. Assuming that variation in Z is negligible, pressure variation along the wall of the contraction, as obtained with Bernoulli's Theorem, is also shown in Fig. 7. In some problems, the details of pressure or velocity variation along the conduit wall are very important. Thus, if the pressure in the discharge conduit is low, it is apparent that the contraction is liable to cavitate. This cavita-

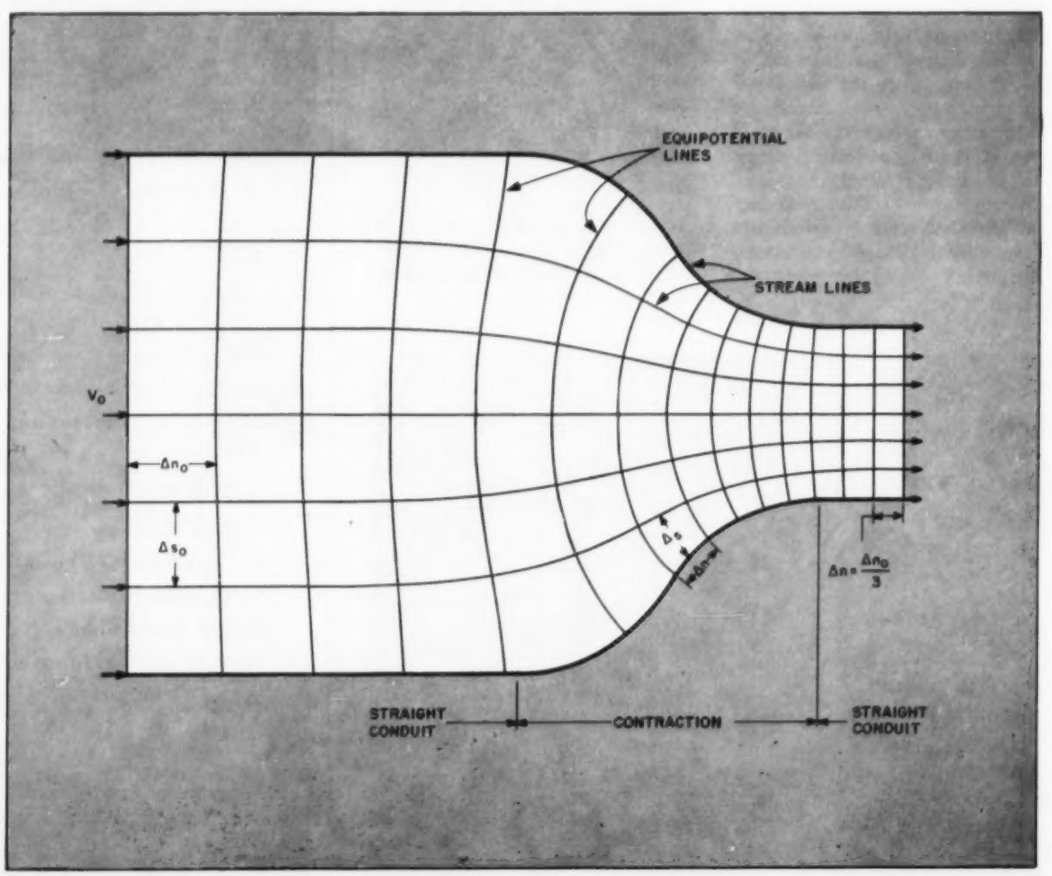

Fig. 5—Flow net of streamlines and equipotential lines for 3:1 plane (two-dimensional) contraction.

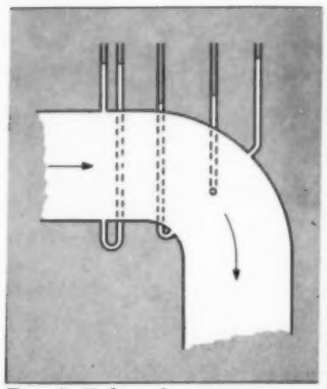

Fig. 6—Tubes show pressure in fluid flowing around bend is greater at outer than inner wall.

tion will first occur along the wall near the end of the contraction.

Two special types of rotary motion occur often enough to be of particular interest. These are usually termed the free vortex and the forced vortex. In both cases the fluid moves in concentric circles, but the way in which velocity varies with radius differs. The variation in pressure with radius is therefore also considerably different for the two vortex motions.

what is forced vortex motion?

Forced vortex motion may be produced by rotating a bucket of water, say, about its axis at a constant angular speed. The fluid rotates without motion relative to the bucket. This is sometimes termed solid body rotation since the variation of velocity with radius is that which would occur if the fluid were a solid. We can say that

$$V = r\omega \qquad (7)$$

where r = radius and ω = angular velocity, a constant for any particular motion. The fluid is acted on by a torque and hence work is being done on it. We cannot use Bernoulli's Theorem to ascertain the pressure variation with radius. From the elementary relationship between centripetal force and acceleration and our velocity relationship, we find that in the case of the forced vortex, the pressure variation with radius is parabolic

$$\frac{p}{\gamma} + Z = \frac{r^2\omega^2}{2g} + \frac{p_o}{\gamma} + Z_o \qquad (8)$$

where subscript o refers to the values for $r = O$. In the case of our bucket of water being rotated, the free surface will be that of a paraboloid.

(continues on page 46)

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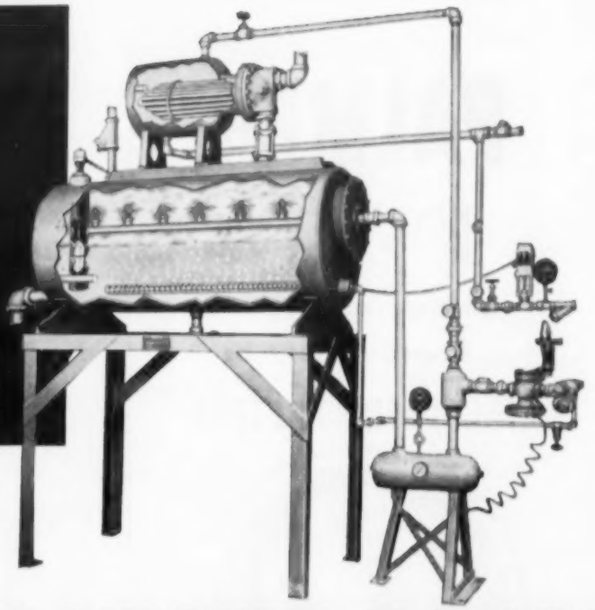

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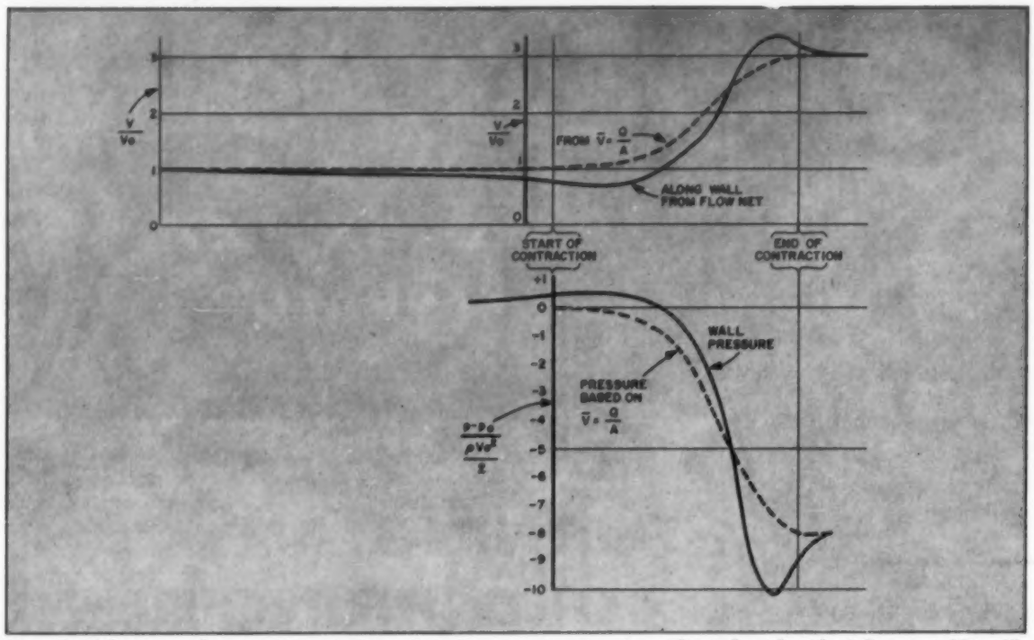

Fig. 7–Velocity and pressure variations for plane contraction is evaluated with aid of flow net (Fig. 5).

The free vortex occurs without torque. In this type, the velocity variation is such that

$$V = \frac{C}{\gamma} \qquad (9)$$

where C is some constant. Since there is no torque applied, the motion is what we term irrotational and we can apply Bernoulli's Theorem across the streamlines to determine pressure variation

$$\frac{p}{\gamma} + Z = \frac{p_\infty}{\gamma} + Z_\infty - \frac{V^2}{2g}$$

$$= \frac{p_\infty}{\gamma} + Z_\infty - \frac{C^2}{2gr^2} \qquad (10)$$

where the subscript ∞ refers to conditions at a large radius. By Eq. 9 we see that at a large radius, velocity is zero. We cannot refer pressures to conditions at zero radius because, in that case, our velocity relationship predicts the impossible value of infinity. This impossible result may suggest that the free vortex is but an imaginary motion which cannot occur in a real fluid. But, such is not the case. To avoid the impossible condition for zero radius, we depict the free vortex as containing a core with solid body rotation. The resultant motion is called the combined vortex (See Fig. 8).

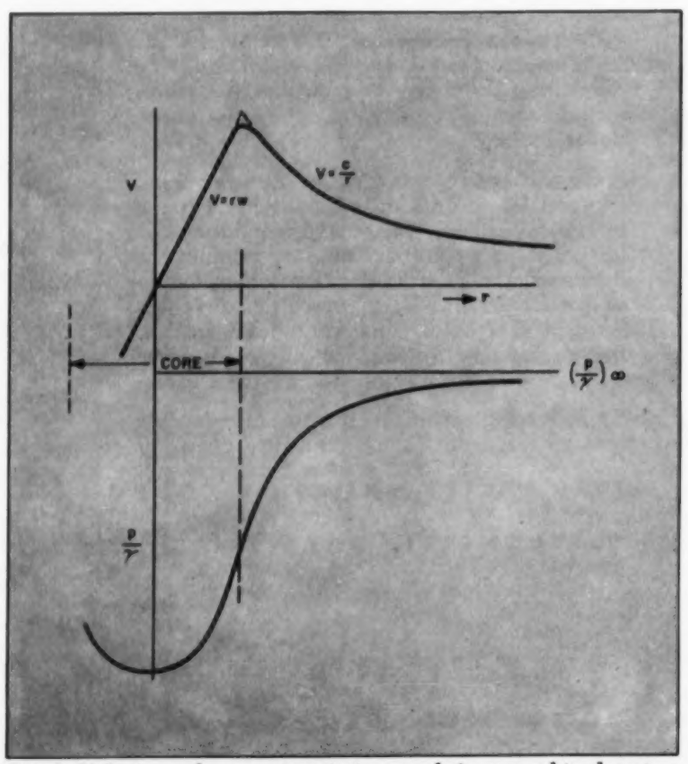

Fig. 8–Velocity and pressure variation graph for a combined vortex.

Vortex motions are not uncommon occurrences. Forced vortex motion tends to occur in the runner or impeller of a centrifugal pump, compressor, or turbine. Free vortex motion tends to occur in the volute outside the impeller or in the flow around bends. A cylone or tornado is a natural case of free vortex motion with, of course, a core of solid body rotation. In the case of water flowing out of a bathtub, we also have the natural occurrence of free vortex motion with the core occupied by an air funnel. ◆◆

handy guide

. . . starts on page 34

129-Ramblings on instrumentation

Hays president continues his chats on boiler plant control systems, this month reviewing combustion controls. Read page 33 — THE HAYS CORP.

407-All purpose rotameter handbook

Catalog describes indicating recording, controlling, and integrating flowmeters for liquid and gas measurement. Capacities; corrosion-resistant properties; and unique features of full-view, armored purge meters and rotameter equipment are given. Sixty-eight pages. BROOKS ROTAMETER CO.

408-Engineering data on analyzers, recorders

Catalog 56-1008-59 describes Hays Condu-Therm Analyzer and Acratron electronic recorder. Analyzer uses thermal conductivity method of analysis to determine amount of CO_2, H_2, He, CH_4, etc. Describes gas sampling systems in separate section. Twelve pages. THE HAYS CORP.

611-Switch to centralized control

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Electronic devices: fundamentals and uses

"Electronics in Industry" by George M. Chute, University of Detroit electrical engineering professor, gives basic fundamentals of electronic devices and shows how they are used in practical circuits. Subjects include review of electronic applications for welding controls, speed and voltage regulators, amplifiers, servomechanisms, high-speed light relays, many others. 432 pages. $7.50. MCGRAW-HILL BOOK CO., INC., 330 West 42nd Street, New York 36, N. Y.

LIGHTING

409-Get more from your plant lighting

Bulletin V-501 stresses importance of plant lighting as a tool for increased production. Includes sections on safety and visibility factors; plant lighting standards; uses and maintenance of fluorescent, incandescent, and mercury vapor lamps. Twenty-eight pages. SYLVANIA ELECTRIC PRODUCTS INC.

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113-Stop motor burnouts

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410-Plug valve lubricant catalog

Bulletin 39-5A gives lubricant recommendations for over 3900 service conditions for which lubricated plug valves can be used. Also shows accessories, fittings, automatic lubricators, lubricant guns. Sixteen pages. HOMESTEAD MANUFACTURING CO.

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MAINTENANCE ITEMS

108-Easy maintenance on commutators, slip rings

Investigate Ideal way to restore commutators and slip rings without dismantling. Read page 44 — IDEAL INDUSTRIES, INC.

133-Equipment grouting easy as 1-2-3

Embeco pre-mixed grout is ready to use, flowable, and non-shrinking. Read page 41 — MASTER BUILDERS CO.

143-Planned maintenance helper

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127-Patch wears like iron

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101-Gaskets hold high pressures

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411-Stainless steel data book

Design and dimensional information on flange drilling templates, flange and ring-joint facings, stainless steel pipe, pipe threads, pressure-temperature ratings and conversion factors, resistance to fluid flow, hardness conversion tables, physical, and mechanical properties of stainless steel are covered. Detailed materials selection chart for more than 300 corrosive solutions is included. Sixteen pages. COOPER ALLOY CORP.

412-Pocket-size steel data book

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413-How to design belt conveyor

Engineering data required to design a belt conveyor for any application are presented in Catalog 852. Standardized units are recommended whenever possible. Eighty-six pages. THE JEFFREY MFG. CO.

614-Bulk handling as a business

Case history tells how one California company processes bulk rubbish to salvage useful materials. Economical, dependable conveyor operation is vital to this process. INDUSTRY POWER reprint.

615-Conveyors for hot materials

Efficient, low-cost handling of hot bulk materials (over 400 F) demands careful selection of proper conveyor system components. Experience proves certain conveyor materials especially suited to severe conditions. INDUSTRY POWER reprint.

NUCLEAR

147-Skill comes to the surface

Westinghouse skill that engineered Mark II atomic engine in U.S.S. Nautilus now is directed toward first U.S. nuclear fleet. Read page 32 – WESTINGHOUSE ELECTRIC CORP.

414-Engineering for atomic power

Nuclear engineering in war and peace is covered in attractive brochure "Engineering for Atomic Power." Nuclear projects handled by this consulting engineering firm include Shippingport reactor, Army reactor (APPR), the Manhattan Project. Thirty-eight pages. STONE & WEBSTER ENGINEERING CORP.

415-Power reactor systems for electric generation

Written in lucid, non-technical language, Bulletin GER-1384 describes power reactor systems for commercial electric generation. Reference chart gives pertinent design data on power reactors now in commercial use. Twenty-eight pages. GENERAL ELECTRIC CO.

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Type S pumps satisfy 85% of all chemical pumping needs. Read page 25 – PHILADELPHIA PUMP DIV.

417-Engineering specs on centrifugal pumps

Bulletin 4011-A describes end-suction centrifugal pumps from 1- to 5-inch discharge with capacities up to 1000 gpm at 75 feet head, and 100 gpm at 250 feet head. Includes performance tables, curves, and ta-

(continues on page 50)

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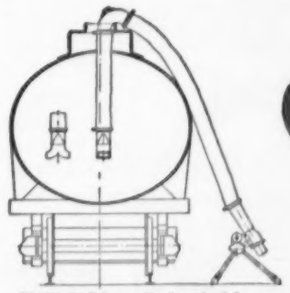

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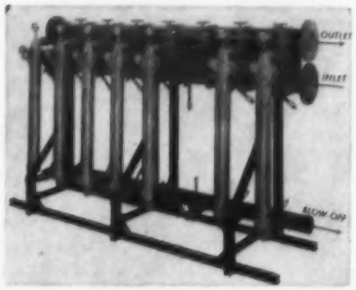

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423-How to choose the right valve

Quick-reference chart for diaphragm material selection aids in choosing right valve for any application. Bulletin 104 describes diaphragm valves for positive closure and plastic valves and diaphragms for corrosive services. Bulletin includes complete mechanical and engineering data. Twelve pages. HILLS-MCCANNA CO.

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425-Guide to water-conditioning systems

"Water Conditioning — One Source for Every Need," Bulletin 611B, describes products available from this company and explains how each type solves particular problems. Nineteen pages. Elgin Refinite Div., Elgin Softener Corp.

426-How to remove scale and rust

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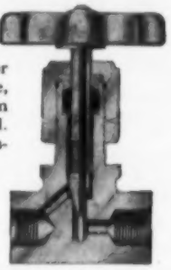

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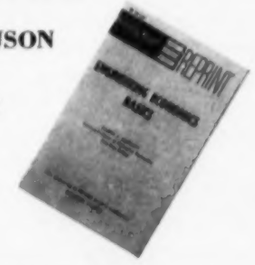

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The Editors

P.S. Many "paid" magazines have substantial "controlled" circulation . . . . up to 30 percent is permitted by postal regulation. And many publishers of "paid" magazines have "controlled" magazines in their stable, too. That IS strange.

coming events

Sept. 9-13:
ISA Instrument-Automation Conference and Exhibit; Cleveland Auditorium, Cleveland.

Sept. 9-13:
Illuminating Engineering Society National Technical Conference; Biltmore Hotel, Atlanta, Ga.

Sept. 20:
National Records Management Council, Inc. Conference on Records Management; Hotel Roosevelt, New York City.

Sept. 23-25:
ASME Fall Meeting; Hotel Statler, Hartford, Conn.

Sept. 24-25:
Joint IRE-AIEE Symposium on Industrial Electronics; Morrison Hotel, Chicago.

Oct. 7-9:
ASLE-ASME Lubrication Conference; Royal-York Hotel, Toronto.

Oct. 7-9:
National Electronics Conference; Hotel Sherman, Chicago.

Oct. 7-10:
Federation of Sewage & Industrial Wastes Association Annual Meeting; Statler Hotel, Boston.

Oct. 7-11:
AIEE Fall General Meeting; Hotel Morrison, Chicago.

Oct. 8-9:
Industrial Coal Conference; Purdue University, West Lafayette, Ind.

Oct. 10-11:
National Noise Abatement Symposium; Hotel Sherman, Chicago.

Oct. 10-12:
AIME Fuels Conference; Chateau Frontenac, Quebec.

Oct. 21:
Air Pollution Symposium; The Franklin Institute, Philadelphia.

Oct. 21-23:
Engineers' Society of Western Pennsylvania Annual Water Conference; Penn Sheraton, Pittsburgh.

Oct. 21-25:
National Safety Congress and Exposition; Conrad Hilton, Congress, Morrison, and La Salle Hotels, Chicago.

Oct. 28-30:
American Nuclear Society Winter Meeting; Henry Hudson Hotel and Coliseum, New York City.

Oct. 28-31:
Trade Fair of the Atomic Industry; Coliseum, New York City.

Oct. 30-31:
Industrial Hygiene Foundation Annual Meeting; Mellon Institute, Pittsburgh, Pa.

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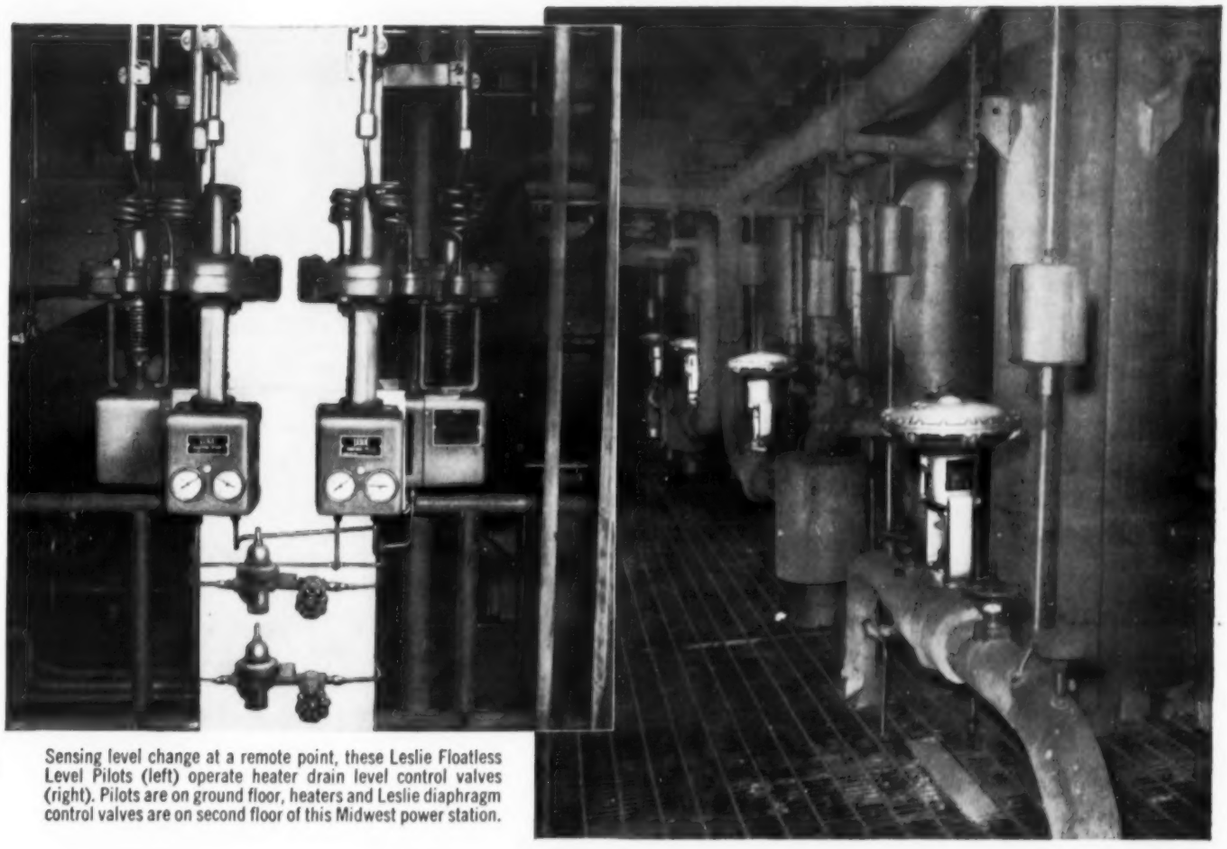

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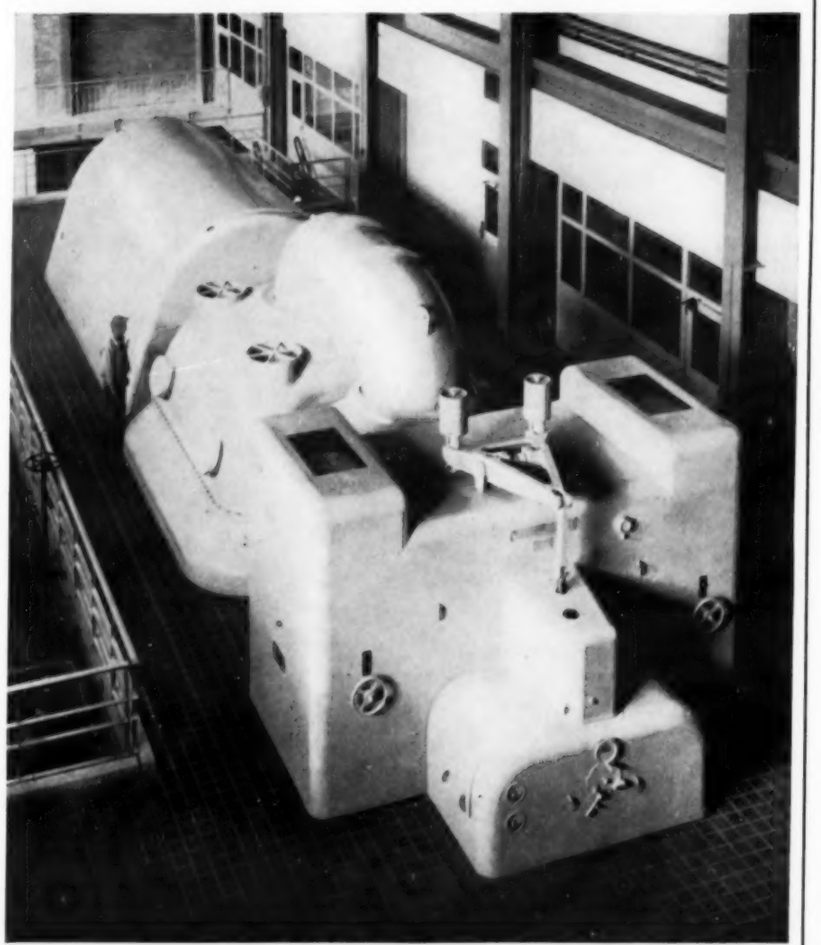

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